SCIENCE

NEW SERIES. VOLUME LII.

JULY-DECEMBER, 1920

NEW YORK
THE SCIENCE PRESS
1920

THE NEW ERA PRINTING COMPANY,
41 North Queen Street,
Lancaster, Pa.

CONTENTS AND INDEX.

NEW SERIES. VOL. LII.—JULY TO DECEMBER, 1920

NAMES OF CONTRIBUTORS ARE PRINTED IN SMALL CAPITALS

SCIENCE

FRIDAY, JULY 2, 1920

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE FOUNDING OF THE WISCONSIN ACADEMY OF SCIENCES, ARTS AND LETTERS

THE event we are met to commemorate was a quiet one in itself. It took place without noise or pageantry. But none the less, in the intellectual history of the people of this commonwealth, it was a signal event. The founding of the Wisconsin Academy of Sciences, Arts and Letters, though quite without the paraphernalia of a great event, was yet a most distinctive step in the passage from the first stage in the intellectual evolution of our people into this, the second stage.

The first stage, it is needless to say, was that of pioneer development. It began with the coming of our forefathers into this goodly land between the Great Lake and the Great River. The territory was then in its virgin state, tenanted by the wild life that had taken possession of it on the retreat of the Great Ice Invasion. This first stage was a period of pioneer struggle and this struggle almost necessarily delayed certain forms of scientific and cultural development. This pioneer stage continued not only until the virgin prairies, the wild meadows, the park-like groves, and the trackless forests of Wisconsin had been replaced by cultivated fields, comfortable dwellings and prosperous towns, but until all these had been bound together by a network of roadways and railways that united the whole into an intercommunicating co-operative community ready to enter upon a common organized career in pursuit of its higher interests.

The second stage could really begin only

when the conditions were thus ripe for unified efforts to develop the higher intellectual, ethical and esthetic interests of the community. I think you will agree with me that no step toward this higher evolution could be more fundamental than the beginning of a concerted endeavor to search out rigorously, to test and to make known the basal truths that conditioned the lives of the Wisconsin people: our habitat, the native life of the land, our material inheritances, our climatic and other physical surroundings, our social and moral conditions, our political institutions, as well as the arts and the literatures that made it possible to use these most effectually. I do not think that the partiality of the occasion leads us beyond the realities, when we regard the founding of the academy as at least the most representative step in this new development. It was of course by no means the only step, nor was it the pioneer step in the transition from primitive conditions to the more mature civilization to which the state has since attained; for, in addition to the effective work of the schools and the churches, which had taken on broader aspects and become more efficient as the passing of primitive conditions permitted, the State Historical Society, the State Agricultural Society, the State Teachers' Association, and other organizations had already taken up their special tasks and had become effective agencies of progress; but, none the less, the founding of the academy was the most representative event in the turn to the new order of things, for, better than any other single event, it typified the coming of a higher order of endeavor, in that its distinctive feature was cooperative research for the common good, and this, I think you will agree, is the most basal and truest index of real progress.

The movement furthermore was a comprehensive one, and altruistic; it was unrelated to special interests. It was entered upon spontaneously in full realization of the sacrificial labors that would be necessary to make the enterprise a real success. And so, in its high purpose and in its sacrificial spirit, this coming together, fifty years ago, of good men from all parts of the state to found an academy whose chief purpose was to facilitate a concerted search for truth for the common good, stands forth as an altogether signal event in the intellectual development of our people.

THE PIONEER PREPARATORY STAGE

But before we pass on to review with gratitude and appreciation the work of the founders of the academy, let us pay a passing word of respect to the pioneers who paved the way for the later era. Let us also not altogether pass in silence the native conditions which became our inheritance and which contributed more than perhaps we realize to what Wisconsin now is and is likely to be.

To one who saw the primitive wildness of this region as it was vanishing and who played his little part in the early struggle to replace the unbroken sod with cultivated land, it is a pleasure to recall this early epoch and all that it meant to the founders of the state. The primitive wildness had a charm which no one who saw it can easily forget, and the struggle with this wildness, strenuous as it was, had in it such an imperative call for personal resourcefulness and such a toughening of physical and mental fiber as one would not wish to have escaped. It brought its hard lessons of self-dependence, of adaptation, of courage and of tenacity. It would be a pleasure to dwell at length upon the primitive aspects of Wisconsin clothed in the charm of its

untouched nativity, but I must confine myself to that one phase which stimulated some of the special intellectual activities which led up to the event we celebrate.

Virgin Wisconsin was a Paradise for the naturalist. Its situation gave it rare advantages. Its latitude placed it in the mid-zone of the teeming life that migrated annually between the high north and the genial south, while its longitude placed it in a peculiarly rich tract of that zone. The great lake on its eastern border served as a broad blunt wedge which parted the migrating host into two great divisions: on the one hand, the forest lovers who sought the wooded regions of the northeast in summer and the like regions of the southeast in winter; on the other hand, the prairie lovers who preferred the great open plains. Between these there was a middle zone and a middle host formed in part of the overlap of the two other hosts, but in part also of those species which distinctly preferred the border tract of "openings," the parks of interspersed prairie, meadow and woodland, lying between the great forests and the great plains. The southern and western part of Wisconsin was one of the most charming sections of this great border tract of natural parks. Through this parkway there swept northward each spring and southward each fall a mixed multitude of winged life that now, in its depleted state, seems really incredible. The great woods of the north and northeast, with Lake Superior in their rear, tended to shunt this host to the northwest and caused congestion on their front. If I were to try to tell you in specific terms of the richness and variety of life in springtime, as I remember it, I fear you would feel impelled to call into service the famous mot of Von Buch: "I am glad you saw that; for if I had seen it, I would not have believed it."

Out of the irresistible attractions of the native life of the air, the woodlands, the grove-encircled prairies, the meadows, the marshes, the limpid streams, and the charming lakes of Wisconsin, there grew the first notable stage of spontaneous scientific activity, the stage of the enthusiastic naturalist. It was quite in the natural order of things that where personal conditions favored, as among surveyors like Lapham and among doctors of wide country practise like Hoy, there should arise enthusiastic students of the rich fauna and the flora of the region, as also of the land that lay beneath and of the sky that hung overhead. This stage of naturalistic enthusiasm reached its climax somewhat before the general conditions in the state were ripe for the founding of the academy; and so the pioneer naturalists of Wisconsin, particularly Lapham and Hoy, may be regarded as the forefathers of the academy quite as truly as its founders. Though the naturalist stage had already somewhat declined when the time for the inauguration of the academy had come, it was a very essential preliminary to the founding of the academy.

THE IMMEDIATE PRE-PERIOD OF PREPARATION

The thirties, the forties and the early fifties of the last century were eminently pioneer days. With the sixties came the Civil War, and with the mid-sixties, its close. It left the natural aftermath of war, diverse currents and counter currents of thought and feeling setting in devious directions—on the one hand, a desire for peace and rest, for cessation of serious thought, for physical, mental and even moral relaxation; on the other hand, when these first desires were in some measure satisfied, a resumption of the tension that had become habitual in the war, a new impulse to tenacious pursuit, a new will to

victory. The larger vision that came with the wider interests and experiences of the war, visions of that which was national rather than personal, entered into the new mental attitude. The man whose pre-war thoughts had centered on his farm, his town, or his county, had been forced to dwell on his state and his country at large and he could not permanently shrink back to his former limitations of interest. The man who had marched shoulder to shoulder could not well relapse into personal isolation. And so the half decade following the war became the generative period of these broader views and those generous instincts of coordination that led to the organization of a common effort for the intellectual development of the state. This was the immediate pre-period of the founding of the academy.

THE FORMAL FOUNDING OF THE ACADEMY

During this half-decade, voluntary organizations were formed here and there for the promotion of science and for personal culture, and some futile efforts of a more general order were made, all of which were more or less tributary to the coming general movement. Encouraged by these symptoms of readiness, Dr. J. W. Hoyt, secretary of the State Agricultural Society, worked out a comprehensive scheme for a State Academy. He sent printed copies of this to such citizens of the state as were thought to be interested in such a movement, whether or not they were likely to be able to engage in research or to make contributions to any phase of science, arts, or letters. He also proposed that a convention be called to organize such an academy. The proposals met with a cordial response and a special call for the proposed convention was issued bearing the signatures of 105 representative men of various callings and intellectual interests. In explanation of my presence here to-day and my effort to serve you as requested by your president, I may be permitted to say that my name formed the tail end of the list, and that is perhaps why "the rider of the pale horse" has thus far overlooked me in his frequent and fateful visitations. If he shall continue to feel that the vanishing end of the long list is too immaterial to require any notice on his part, his good judgment will meet with my most hearty concurrence.

The convention met on February 16, 1870, and proceeded with great unanimity to organize the Wisconsin Academy of Sciences, Arts and Letters. A constitution was adopted, officers elected, provision made for incorporation and for the other requirements of a new organization. The constitution provided for three departments, embracing respectively the sciences, the arts and letters. Only the first of these was organized at the initial meeting, but a fuller organization was effected during the ensuing year.

The general purpose of the academy was declared to be the encouragement of investigation and the dissemination of correct views of the various phases of science, literature and the arts. The special purposes of the Department of the Sciences were declared to be general scientific research, a progressive and thorough scientific survey of the state under the direction of the officers of the academy, the formation of a scientific museum, and the diffusion of knowledge by the publication of original contributions to science; that of the Department of Arts to be the advancement of the useful arts through the application of science and the encouragement of original invention; the encouragement of the fine arts and the improvement of the public taste by original contributions to art and by the formation of an art museum; that of

the Department of Letters to be the encouragement of philological and historical research, the improvement of the English language, the collection and preservation of historic records, and the formation of a general library.

Thus took place, fifty years ago, the formal founding of the academy.

THE SUBSTANTIAL ESTABLISHMENT OF THE ACADEMY

As already implied, this formal inauguration of the academy represented rather the ideals and aspirations of those who gave it countenance, than a substantial banding together of real workers in science or scholarship. It is unnecessary to say that the future of the academy as a vital working institution depended almost wholly upon the persistent and sacrificial endeavors of men personally devoted to research and to culture. Scarcely a dozen of those who signed the call for the convention were productive workers in any of the fields embraced within the purposes of the academy. The more comprehensive clientele sought for the academy at the outset was altogether laudable and the sympathy and encouragement of this larger body were very helpful, but I assume that you who now form the working members of the academy and are to hand it on to the next generation, care most to learn who were the real leaders in giving working vitality to the academy in those earliest days, all the more so because certain vital phases of this essential feature of the enterprise linger only in vanishing impressions and fading memories and will soon be lost if not now recorded.

The important part played by Dr. Hoyt in planning so broadly and in urging so successfully the initial steps, has already been indicated. This service was recognized by choosing him first president of the academy. He was thus enabled to round out the formal organization of the academy on the comprehensive plan adopted. He had the merit of assiduity in calling into activity the latent as well as active talent available in the state at the time. Though not a special worker in any line of research, his intellectual sympathies were wide, his aspirations were high; his dream for the academy was ambitious.

The working nucleus of the academy at the start was the group of enthusiastic naturalists who had grown up under the stimulus of the pioneer conditions. Among these I beg to include those who studied the strata beneath and the sky above, as well as those devoted to the plants and animals that tenanted the surface. Foremost among these, by common consent, was Dr. I. A. Lapham, of Milwaukee, then already a veteran scientist. By profession a civil engineer, he had become at an early day a faithful collector, observer and recorder of natural phenomena in nearly all leading lines from bed-rock to sky. He was at once a botanist, a zoologist, an archeologist, a geologist and a meteorologist. He was a distinguished example of the best order of the old school of all-round students of natural science. Probably we owe to Dr. Lapham, more than to any other single individual, the establishment of our Weather Service. He served as the first general secretary of the academy.

Scarcely less active and influential in giving vitality to the academy at the start was Dr. H. P. Hoy, of Racine, an intimate friend and coworker of Lapham's in early naturalistic work. He had already become a veteran student of birds, insects and fishes, and was also an enthusiastic collector of plants and of fossils from the ancient crinoid fields of Racine. He was also an eager student of the relics of aboriginal

life. Lapham was quiet and modestly demonstrative, but Dr. Hoy so bubbled over with enthusiasm that he easily set the pace in demonstrative interest. He was chosen as the second president of the academy. Dr. J. G. Knapp, of Madison, was a frequent contributor in several naturalistic lines, as was also Dr. Engelmann, of Milwaukee, but the former soon moved from the state and the latter was removed by death.

In the physical sciences, Dr. John E. Davies, of the state university, was at first perhaps the leading contributor, with Dr. J. H. Eaton, of Beloit, and Drs. R. Z. Mason and J. C. Foye, of Appleton, as almost equally active coworkers. Dr. Eaton was perhaps the only original member of the academy who had any notable academic training in technical research. A graduate of Amherst, he had won a Ph.D. at Göttingen by his researches on the compounds of manganese.

In the field of political economy and social science, at the outset, advancement was sought more by rational discussion than by rigorous determinations of basal data; and so there was more general participation in the discussions than in the more specific sciences. The most active leaders were President A. L. Chapin, of Beloit (chosen third president of the academy), President G. M. Steele, of Appleton, Superintendent Samuel Fallows, the Reverend Charles Caverno, Professor A. O. Wright, and later President John Bascom, Reverend Dr. Holland and others.

Though not active at the very outset, Dr. Wm. F. Allen, of the state university, soon began a memorable series of papers replete with specific historical research. These set a high standard of true original investigation in humanistic lines. From his scholarly papers some of us caught our first realizing sense of what constitutes original research in history.

Dr. Feuling, of the state university, was at the start a rather lonesome leader in philological research, but the fewness of workers in this line was offset by the quality of the papers offered.

An attempt was made to give speculative philosophy a distinct place in the work of the academy under the leadership of Dr. S. H. Carpenter, of the university, but the effort scarcely survived his early death.

Diversity and picturesqueness were given to the heavier parts of the program by the sprightly literary contributions of the inimitable Dr. Butler.

EARLIER AND LATER TRENDS OF THE ACADEMY

As already noted, the formal organization of the academy was distinctly broad, and there was a general desire and a definite effort to preserve an appreciative and balanced attitude toward all phases of research and of culture. None the less almost inevitably distinct trends disclosed themselves almost from the start, and new trends appeared in close succession, partly due to the new men that came to the state, and partly to the development of young talent within it. Of the papers presented during the first two years, 35 per cent. related to geological subjects, 23 per cent. to biological, 17 per cent. to physical and mathematical science, 15 per cent. to political and sociological subjects, and the remaining 10 per cent. to historical and philological subjects or to topics not readily classified. A distinct geological trend at the outset is thus disclosed and the preponderance grew for a time. This special activity was due partly to charter members, particularly Lapham, Eaton and Chamberlin, but also, in a quite notable degree, to the advent of Professor R. D. Irving, who came to the state in the year following the founding of

the academy. He came with excellent training and the advantage of some field work, and at once took an active part in leading geological inquiry along sound scientific lines. Irving was chosen fourth president of the academy. Two years later a systematic Geological Survey was instituted by the state, largely through the influence of members of the academy, and this not only gave unusual opportunities for productiveness in this line, but helped to develop young talent that made itself felt in the later activities of the academy.

Soon after the founding of the academy, the great movement toward a higher order of things in agricultural science and practise began and at first was most definitely represented by the chemical work of Professor W. W. Daniells. The developments in agriculture were more closely connected with the State Agricultural Society and particularly with the state university than with the academy, but the academy claims some little merit for this most signal development.

About the same time also Major Nicodemus and Captain Nader took the lead in developing interest in engineering themes by notable and stimulating discussions.

There has been occasion to lay emphasis on the type of study of plants and animals, most familiarly known as natural history, which prevailed at the founding of the academy and in the preceding pioneer stage. The career of the academy was scarcely more than under way before this began to give place to modern biological inquiries, and this led on to those important ecological and other studies that characterized the later official surveys and that mean so much to the intellectual and material welfare of the people of the state. This was perhaps the most notable change of trend in the intimate work of the academy. It was led by a young man who came to the state in the fifth year of the academy and has given the academy one of its most prolonged and valued series of papers. Then a young man, we now delight to honor and revere him as president at once of the academy and of our state university, President Birge. A systematic phase in this modern departure was a little later admirably illustrated by the important contributions of Professor and Mrs. Peckham.

By the end of the first decade of the academy's life, it had undergone further changes and had taken on much more distinct diversity. It thus began the better to represent the varied intellectual development which the state was rapidly coming to enjoy, and which it has more fully realized in these later years.

By the end of the second decade the divergencies toward the later phases of the academy became still more marked. The distinctions of departments, that were rather formally defined at the outset, began to fade away, while the departments themselves grew more divergent. A more cosmopolitan spirit arose which made less of subjects and more of method and real intellectual advance. The formative period was being merged into what now seems to a founder "the Golden Era" of the academy. Doubtless intrinsically, it was no better than later stages—perhaps not so good—but these are the days of relativity and to one who felt the struggle and the weakness of the start, it seemed golden.

With it there came rapid changes in the personnel. The veteran naturalists passed away and other losses were many and grave. But the chief changes came from two other sources. The educational institutions of the state were rapidly developing in research lines and there came to the state many able men, well equipped and productive. It would be easy to begin the list—for there was Trelease and the lamented

Barnes—and to go on at length, but where could I end it? Besides, it is not my function to deploy the Golden Age of the academy, but merely its founding. The other source of change came even closer to the hearts of the founders, the coming of choice youth of the state into productive membership in the academy, the children of the academy. They were equally and perhaps more the children of the educational institutions of the state, but we claim them as children of the academy none the less. Very notable among these was President Van Hise, who rapidly rose to leadership in the state, in the nation and beyond. It would be a delight to name many others, but how could the parental affection of a founder permit him to stop short of naming all the children of the academy? The dilemma is in itself evidence that the formative stage of the academy had already passed away. The founding of the academy had really taken place.

THOMAS CHROWDER CHAMBERLIN
UNIVERSITY OF CHICAGO

SCIENTIFIC EVENTS

AITOFF'S EQUAL-AREA PROJECTION OF THE SPHERE

A PROJECTION of the whole sphere on an equivalent or equal area system devised by Aitoff, has just been issued by the U. S. Coast and Geodetic Survey, size 11 inches, price, 15 cents.

The sphere is represented within an ellipse with major axis twice the minor axis. No shoreline has been included since it is intended primarily for the plotting of the stars in astronomical work, its value for this kind of work being suggested by Professor Benjamin Boss, of the Dudley Observatory, Albany, N. Y.

The projection is bounded by an ellipse similar to that which is used in Mollweide's equal area projection but, since the parallels are curved lines, the distortion in the polar regions is less in evidence. The net-work of meridians and parallels is obtained by the orthogonal or perpendicular projection of a Lambert meridional equal area hemisphere upon a plane making an angle of 60° to the plane of the original.

The fact that it is an equivalent or equal area projection combined with the fact that the celestial sphere is represented in one continuous map, will show at a glance the relative frequency of stars in the different regions of the expanse of the heavens. As constructed the radius of the sphere to be projected is taken as a decimeter so that the graticule has a very convenient size for general use.

As used for a map of the world, this projection is well adapted to replace the Mercator

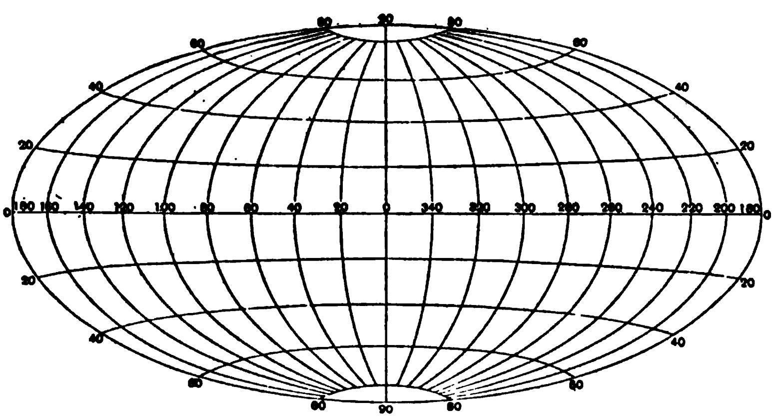


FIG. 1.

projection in atlases of physical geography or for statistical purposes and has the advantage over Mollweide's in that its representation of the shape of countries far east and west of the central meridian is not so distorted because meridians and parallels are not so oblique to one another.

By employing the meridian of Greenwich as a central meridian, the continental masses can be mapped where the projection is at its best and the greater distortion transferred to the Pacific Ocean.

RETIREMENT OF CIVIL SERVICE EMPLOYEES

THE act providing for the retirement of civil service employees is now effective. It applies to employees who have been in the classified service 15 or more years and who have reached the age of 70 years (65 years in the case of mechanics). Employees eligible for retirement are divided into six classes depending on length of service, and the maximum and minimum annuities in each class are specified by law, being contingent on the average annual basic salary for the last 10 years of service. The classes, maximum rates and annuities are as follows:

A. Service, 30 years or more; annuity, 60 per cent. of salary; maximum, \$720; minimum, \$360.

B. Service, 27 years; annuity, 54 per cent. of salary; maximum, \$648; minimum, \$324.

C. Service, 24 years; annuity, 48 per cent. of salary; maximum, \$576; minimum, \$288.

D. Service, 21 years; annuity, 42 per cent. of salary; maximum, \$504; minimum, \$252.

E. Service, 18 years; annuity, 36 per cent. of salary; maximum, \$432; minimum, \$216.

F. Service, 15 years; annuity, 30 per cent. of salary; maximum, \$360; minimum, \$180.

Employees to whom the retirement provisions of the act apply shall, within 90 days of the passage of the act or within 90 days after reaching the retirement age, be automatically separated from the service. In cases where the responsible administrative officers certify to the Civil Service Commission that employees who have reached the retirement age but by reason of efficiency and willingness to remain may be advantageously continued in the public service, such employees may be retained for successive terms of two years.

Beginning with August 1, 1920, there will be withheld each month 2½ per cent. of the basic salary of each employee in the classified service.

THE MEYER MEMORIAL MEDAL[1]

FRANK N. MEYER was an agricultural explorer in the Office of Foreign Seed and Plant Introduction, Bureau of Plant Industry, U. S. Department of Agriculture. For thirteen years he searched through China, Turkestan and other parts of Asia, for plants which might be valued additions to American agriculture and horticulture. When he lost his life on the Yangtze River in 1918,[1] he left a bequest of a thousand dollars to the staff of the Washington Office. The individuals of the Office have put the bequest into a permanent tribute to his memory, in the shape of a medal, designed by Theodore Spicer-Simson, which is to be awarded for distinctive service in plant introduction. The awards are to be made by the Council of the American Genetic Association.

The first award was made on May 8, 1920, when the medal was presented to Mr. Barbour Lathrop. Dr. David Fairchild, in behalf of the Council, presented the medal. Mr. Lathrop had a large part in the founding of the Office of Foreign Seed and Plant Introduction, and has been intimately connected with it since. He and Dr. Fairchild comprised one of the first exploration expeditions, and visited the West Indies, South America, Europe, Egypt, India, Ceylon and the East Indies. Many introductions now growing in this country were secured on this and subsequent trips which Mr. Lathrop conducted and financed. The first seed of the Egyptian cotton, the culture of which now amounts to \$20,000,000 a year in Arizona, was brought in by them. The tropical mangos, now an industry in Florida; the Persian Gulf dates, peculiarly successful in the Imperial Valley; Sumatra wrapper tobacco, now famous in Connecticut; the first large collection of Japanese flowering cherries; Rhodes grass, which has been called the timothy of the

1 From the *Proceedings* of the Washington Academy of Sciences.

South; and varieties of soy beans and the oriental timber and edible bamboos of Japan, which are now represented by groves in various parts of the south, were also secured.

HONORARY DEGREES AT YALE UNIVERSITY

At the recent commencement of Yale University the degree of doctor of science was conferred on Dr. H. P. Armsby and the degree of master of arts on Dr. William Darrach, Professor H. E. Hawkes and Mr. E. W. Nelson. In conferring these degrees President Hadley said:

Henry Prentiss Armsby: A graduate of the Sheffield Scientific School in 1874, specializing in chemistry; doctor of philosophy at Yale, 1879; for several years he was associated with that admirable institution, the Connecticut Agricultural Experiment Station. He has been a teacher in various universities; he is a leading authority on animal nutrition at Pennsylvania State College. He is now director of the Institute of Animal Nutrition at Pennsylvania State College. After the signing of the armistice, he was chosen to go abroad in the commission concerned with food problems in Europe. His career has been a multitudinous blessing.

William Darrach: Was graduated from Yale College in 1897; member of Phi Beta Kappa; took the degree of M.A. and M.D. at Columbia; is now dean of the medical faculty at the College of Physicians and Surgeons. He was attached to Base Hospital No. 2, with commission as captain, and sailed for France in May, 1917; was advanced to the rank of colonel in 1919, and became senior consultant in surgery at headquarters. His publications in scientific research are important. He is a surgeon, a scholar, a teacher and a patriot.

Herbert Edwin Hawkes: B.A., Yale, 1896; Ph.D., 1900; like many of his classmates, Dr. Hawkes became a member of the Yale faculty, and taught mathematics for twelve years. In 1910 he was called to Columbia as professor; he was such a conspicuous success in administration that he was made dean of the college. He is the author of books in his chosen field, but his chief distinction is a worker of miracles—he has made hundreds of young men love mathematics. Perhaps they would not love mathematics so much if they did not love him even more. A living force in education.

Edward William Nelson: A distinguished naturalist and one of the first ornithologists in the world. He has been on scientific expeditions in the Arctic and Torrid Zones, and is at home everywhere. He was in Alaska in 1877, with the expedition in search of the Jeanette in 1881, and has spent many years of scientific conquest in Mexico. He has published authoritative monographs on the birds of Bering Sea and on the squirrels of Central America. He is chief of the Biological Survey in the U. S. Department of Agriculture. During the war, he was constantly employed, and he discovered the best method of ridding the trenches of undesirable visitors; thus making the study of natural history contributory to social science. He leaves for Alaska to-day.

The degree of doctor of laws was conferred on Sir Auckland Campbell Geddes, member of British Parliament, formerly professor of anatomy, British ambassador to the United States.

SCIENTIFIC NOTES AND NEWS

The Albert medal of the Royal Society of Arts has been awarded to Dr. A. A. Michelson, professor of physics in the University of Chicago.

Dr. Edgar F. Smith, retiring provost of the University of Pennsylvania, after conferring degrees and giving the commencement address, received from Dr. William Pepper, dean of the medical school, the doctorate of medicine, conferred at the special request of the faculty of the school of medicine.

Harvard University has conferred its doctorate of science on Dr. W. W. Keen, of Philadelphia, and Dr. H. M. Biggs, of New York.

The doctorate of science has been conferred by Tufts College on Dr. Arthur B. Lamb, professor of chemistry at Harvard University.

The degree of master of science was conferred on Major Edward Hall Bowie, forecaster, U. S. Weather Bureau, at the commencement of St. John's College.

The semi-centennial celebration of Iowa State College was held in connection with commencement in June this year, having been delayed nearly two years on account of the war. Four hundred and thirty-five degrees were awarded. No honorary degrees had been given in recent years. Thirteen were conferred

in connection with the semi-centennial celebration, as follows: Doctor of Science to J. C. Arthur, Purdue University; Alfred Atkinson, Montana Agricultural College; Carleton Roy Ball, Washington, D. C.; Isabel Bevier, University of Illinois; Eugene Davenport, University of Illinois; A. S. Hitchcock, Washington, D. C.; L. S. Klinck, University of British Columbia; John R. Mohler, Washington, D. C.; Wilmon Newell, Gainesville, Fla.; R. A. Oakley, Washington, D. C. Doctor of Engineering to W. C. Armstrong, St. Paul, Minn.; A. P. Davis, Washington, D. C.; Thomas L. Smith, Milwaukee, Wis.

MAJOR GENERAL WILLIAM G. GORGAS, former surgeon-general of the United States Army, has been obliged to abandon his mission to West Africa, where he was going to investigate sanitary conditions. Other members of the party, headed by Brigadier General Robert E. Noble, U. S. Army, will proceed thither on June 30. General Gorgas recently suffered in London a stroke of apoplexy, which affected the left side. His condition is still serious and it is planned that he shall return to the United States when he is able to travel.

IN its account of the Imperial Entomological Conference held in London from June 1 to 11 *Nature* says: "Much gratification was felt and expressed at the presence for the first two days of Dr. L. O. Howard, entomologist of the U. S. Department of Agriculture. His brief, pointed remarks at some of the discussions were much appreciated; he deplored some recent attempts to destroy 'entomology' as a specific economic subject by dividing its subject-matter between 'parasitology' and 'phytopathology.'"

DR. C. G. ABBOT, assistant secretary of the Smithsonian Institution, has gone to Arizona to supervise the setting up of a solar observing station in the Haqua Hala Mountains.

PROFESSOR LEWIS KNUDSON, of the College of Agriculture, has returned to Ithaca after a stay of several months in France and Spain. At the request of the Spanish government he visited Madrid and Barcelona, at the Natural Museum of Science he organized a department of plant physiology and gave a course of lectures and conducted a laboratory.

BRIGADIER GENERAL M. T. FINNEY, Colonel John B. Walker and Lieutenant Colonels Robert H. Ivy and Murray S. Danforth, Medical Reserve Corps, have been ordered to Paris, France, for duty at the coming interallied surgical conference.

DR. SEYMOUR HADWEN has resigned his position as chief pathologist in charge of the biological laboratory, Health of Animals Branch, Canadian Department of Agriculture, Ottawa, Canada, and has taken a position as chief pathologist in the Reindeer Investigations of the Bureau of Biological Survey, U. S. Department of Agriculture. His headquarters are Unalakleet, Alaska.

DR. N. E. DORSEY, physicist of the Bureau of Standards, has resigned in order to go into consulting and testing work.

C. H. KIDWELL, chief of the Water Resources Laboratory of the U. S. Geological Survey, has resigned to accept a position with the Solvay Process Company at Syracuse.

CEPHAS HEMPSTONE SINCLAIR, hydrographic and geodetic engineer in the U. S. Coast and Geodetic Survey, died on May 16, in his seventy-third year.

LEONARD DONCASTER, F.R.S., fellow of King's College, Cambridge, and Derby professor of zoology in the University of Liverpool, died on May 28, in his forty-third year.

DR. F. KÖLPIN RAVN, the Danish plant pathologist, died on May 24, at Orange, New Jersey, while on a visit to the United States.

THE U. S. Civil Service Commission announces an open competitive examination on July 27, for psychological investigator in employment tests to fill vacancies in the Bureau of Efficiency, at salaries of $3,000 to $4,000 a year. The position is open to both men and women. Candidates will not be required to report for examination, but will be rated on education, experience and a thesis.

THE following officers and members of council of the Royal Astronomical Society were elected at the anniversary meeting on Feb-

ruary 13: *President:* Professor A. Fowler. *Vice-presidents:* Sir F. W. Dyson, Professor A. S. Eddington, Major P. A. MacMahon and Professor H. F. Newall. *Treasurer:* Mr. E. B. Knobel. *Secretaries:* Dr. A. C. D. Crommelin and the Reverend T. E. R. Phillips. *Foreign Secretary:* Professor H. H. Turner. *Council:* Professor A. E. Conrady, Dr. J. L. E. Dreyer, Dr. J. W. L. Glaisher, Mr. J. Jackson, Dr. Harold Jeffreys, Mr. H. S. Jones, Professor F. A. Lindemann, Mr. E. W. Maunder, Dr. W. H. Maw, Professor J. W. Nicholson, Mr. J. H. Reynolds and Lieutenant-Colonel F. J. M. Stratton.

The members of the Sigma Xi at Northwestern University celebrated on April 20 the one hundredth anniversary of the discovery of the first connection between electric currents and magnetism, made by H. C. Oersted at Copenhagen, a discovery which forms one of the two foundation stones upon which rest our modern electrical industries and wireless communication. President Lynn Harold Hough made some introductory remarks, and Mr. Walter Clyde Jones gave an address on "The Significance of Oersted's Work," which was followed by a conversazione in the laboratory.

A motion picture illustrating the College Experimental Station Bulletin entitled "Life History and Control of the Pocket Gopher of the Willamette Valley," by H. M. Wight, was a feature of the annual open meeting of the Biological Club at the Oregon Agricultural College on April 22. One reel was shown depicting the destructive habits of the gopher on farm land and methods for control. This picture was prepared by H. M. Wight, author of the bulletin, assisted by D. K. Mereen, who conducted all the photographic work, and Mr. J. M. Clifford, of the Experimental Station, who supplied the titles. The program of the evening included an illustrated lecture on "Natural Vegetation as an Indicator of Land Capabilities" by Professor W. E. Lawrence. The regular meetings of the Biological Club are held on the third Tuesday of the month.

Announcement is made by the American Museum of Natural History of a gift by Frederick F. Brewster, of New Haven, Connecticut, of 3,200 specimens of land-birds collected in the West Indies and South America by Rollo H. Beck, under the direction of Dr. Leonard C. Sanford. A large part of this material, according to Dr. Frank M. Chapman, curator of the department of birds, is new to the museum's collections, and much of it is contained in no other museum. The collection includes 1,500 birds from the West Indies chiefly the high mountains of Santo Domingo, from which little-known area there is included a series of the recently discovered Crossbill and Patagonia Sparrow, known heretofore only from a few specimens in the National Museum in Washington; a large series of two distinct new species, known only in the Brewster collection; and the unique type of a new genus of Goatsuckers. There are also 500 birds from Bahia, and somewhat over a thousand specimens from the extreme southern part of South America, including a representative series from Tierra del Fuego and the Falkland Islands, from which localities the museum was wholly without material.

It is noted in *Nature* that a meeting has been held in Brussels of the scientific committee of the Solvay International Institute of Physics, and it was resolved, upon the recommendation of the executive committee, to resume the work of the institute, which had been interrupted by the war. New physical councils will be summoned from time to time, similar to those formed in 1911 and 1913. The president referred to the debt which the scientific committee owed to Dr. R. B. Goldschmidt, of Brussels, for the services rendered by him to the institute during the early years of its foundation. The members of the committee were Professor H. A. Lorentz (president), Haarlem; Mme. Curie, Paris; Sir W. H. Bragg, London; M. Brillouin, Paris; Professor H. Kamerlingh Onnes, Leyden; Professor Knudsen, Copenhagen; Professor A.

Righi, Bologna; Sir Ernest Rutherford, Cambridge; and Professor E. Van Aubel, Ghent.

UNIVERSITY AND EDUCATIONAL NEWS

YALE UNIVERSITY has received from an unnamed graduate a gift of $3,000,000 to the general endowment of the university, contingent upon additional gifts of $2,000,000 by next January, exclusive of those through the alumni university fund. The gift is made to meet increased faculty salaries.

CORNELL UNIVERSITY has received a gift of $500,000 from Mr. August Heckscher, of New York City, for the endowment of research. The income of the fund created by Mr. Heckscher's gift will be used to maintain research professorships and to provide facilities for scientific work.

PROFESSOR FRANKLIN MOON, who has held the chair of forest engineering since 1912, has been elected dean of the New York State College of Forestry at Syracuse.

DR. EDWARD BARTOW, chief of the Illinois State Water Survey Division, has been elected head of the department of chemistry of the Iowa State University.

DR. H. E. WELLS, formerly professor of chemistry at Washington and Jefferson College, has been appointed professor of chemistry at Smith College.

PROFESSOR HORACE GUNTHORP, of the department of zoology and physiology at Washburn College, has accepted an assistant professorship of zoology in the University of Washington, at Seattle.

DR. H. M. DAWSON has been selected to be the occupant of a newly established chair of physical chemistry at the University of Leeds.

DISCUSSION AND CORRESPONDENCE

ORTHOGENESIS AMONG FISHES

IN tracing successions of fishes, extinct and recent, we observe the outlines of a law or generalization, still vaguely understood, which seems to be in line with Eimer's conception of orthogenesis. This is defined as the doctrine that the phylogenetic evolution of organisms takes place systematically in a few definite directions, as contrasted with irregular divergence in many directions.

The facts in brief are these: In certain groups some particular structure will acquire a high degree of development and specialization; this being pursued along what might seem to be a definite determinative line; after which, the structure, being over-developed, undergoes again progressive degeneration, sometimes being altogether lost.

Two series of fishes may illustrate that point: the rock fishes (*Scorpænidæ*), in their most primitive forms are very much like the different types of bass, the chief difference lying in the presence of a peculiar backward extension of the bone under the eye, forming what is called the suborbital stay, and the fact that the skull has spines on its upper surface. We have the elaboration of spines on the head, the elaboration of scales, forming ultimately a series of bony plates, the extension over the head of a coat-of-mail, the elevation of fins, and other modifications. These gradually fading away through the different categories of sculpins (*Cottidæ*), until we come to the sea-snails (*Liparidæ*). These still retain the suborbital stay, but have lost all the hitherto specialized qualities: there are no scales, the body is covered with thin movable skin; there are no spines anywhere on the head or fins, and the fins themselves are very small in size, largly enveloped in the soft flaccid skin.

Quite as remarkable is the process of evolution and transformation of the butterfly fishes (*Chætodontidæ*). Beginning with forms like *Ephippus*, not very different from ordinary bass-like species, these fishes become specialized in very high fins, the reduction of the size of the gill opening and the development of brush-like teeth of the mouth. Passing on further we see the tail provided with bony structures, sometimes with a brush of spines like porcupine quills, sometimes with a sharp cutting lance in a sheath on either side. The scales grow smaller and rougher, the fins being however reduced in height and in

number of spines. Later the scales grow still smaller, becoming like shagreen; bony plates appear, while the spinous dorsal, ventral fins and the gill openings undergo reductions. Later the spinous dorsal and the ventrals disappear altogether, the teeth coalesce into two in each jaw and finally into one in each jaw; this series finding its extreme in the head-fish (*Mola*), in which the body is deeper than long and seems to be simply a great head with a fin behind it.

Turning in another direction, the spinous fins disappearing, the body is covered with bony plates, and these finally interlock with each other, forming a complete bony box absolutely immovable. Species thus provided are known as trunk-fishes (*Ostracion*), and in these the bony plates sometimes extend themselves into spines, especially on the head, which thus acquires a fantastic appearance.

Similar changes are found in other groups, the general rule being extreme specialization of a particular organ, producing its expansion and high development, ultimately followed by its reduction and final disappearance. In each group the species most normally formed are the earliest to appear in geological history, while primitive forms often linger with the others to the present time, most of these groups having their origin in the Eocene. Thus many of these early types, even the earliest, remain to the present day, showing apparently that non-specialization, ultra-specialization and loss of structure are all of secondary importance in the struggle for existence, and that they are conditioned on something else, a law not yet understood.

David Starr Jordan
Stanford University

EINSTEIN'S THEORY AND SHIFT OF SPECTRUM LINES

According to Einstein's theory, as I understand it, any time piece, as *e. g.*, a vibrating atom, automatically goes slow if placed in a strong field of gravitation; also the effect of a gravitational field is not to be distinguished from inertia effects in any accelerated motion. A particular illustration is that of a clock moving in a circle. It would seem that there should not be much difference between the effects of an acceleration produced thus and that produced by magnetic or electric fields.

In the Stark effect, where the radiation from atoms in a strong electrical field is studied, it is probable that some of the radiating atoms are in a charged state. If one computes the acceleration of a hydrogen molecule with one unit of charge in a field of 20,000 volts per cm., without considering the dragging effect of other molecular fields, one finds it to be of the order of 10^{16} cm. per sec. per sec., much greater than the value of g at the sun, so that if the atom could radiate in this state very large displacements in the spectrum lines should be expected, amounting to the appearence of new lines. Even if the atom as a whole is neutral, yet because of the nonhomogeneity of the field and the distance between the positive and negative constituents of the atom, considerable accelerations are to be expected which will be larger according as an electron is farther removed from the central nucleus. It is interesting then to recall that Stark found in several instances a displacement of his central image towards the red end of the spectrum, and found the components unsymmetrically placed, also that in a number of cases entirely new lines have been found.

If the preceding point of view is correct, then in any case of luminosity in a gas, since during "collisions" the atoms are evidently in strong fields of force, a slight displacement of the center of gravity of a line towards the red would appear, and this would increase with the pressure as in the common pressure effect. The explanation of the pressure shift as due to the action of adjacent molecular fields has been given, and according to Einstein's theory that would bring it into accord with the general relativity views of time. The difficulty of distinguishing between the pressure effect and the one predicted by Einstein in the sun has been noted. Is it not possible that this lies in the nature of things, the difference being that while all matter is subject in the same degree to gravitation, the

forces between colliding atoms depends on the nature of the atoms and hence the pressure shift is different for different substances?[1]

ELIZABETH R. LAIRD

MOUNT HOLYOKE COLLEGE,
May 3, 1920

ANOPHELES LARVÆ IN SALT WATER

DR. F. E. CHIDESTER in SCIENCE, Vol. LI., No. 1314, presented some interesting data on the occurrence of certain North American *Anopheles* in brackish water, and referred to Professor Smith's account, which was published in 1904, and which "has been either ignored or discredited."

It may be of interest to call attention to some other *Anopheles* which live in brackish water and which are not included in Dr. Chidester's account. In my paper on the behavior of certain of our Canal Zone *Anopheles* (*Annals Ento. Soc. of America*, 1915, page 235) I gave the chlorine content of samples of water from which larvæ of *Anopheles albimanus* Wiede, *A. tarsimaculata* Goeldi and *Ædes taeniorhynchus* Wiede, were taken. These samples had from 11,250 to 23,500 parts of Cl per million. Considering sea-water as having 22,000 parts of Cl per million, these samples represented from 51.1 per cent. to 107 per cent. of sea-water. There were 38 samples all told, the average Cl content being 15,817 parts per million, or equaling 72.0 per cent. of sea-water.

We get most of our *A. tarsimaculata* from the lowlands at both ends of the Panama Canal.

JAMES ZETEK

ANCON, C. Z.

QUOTATIONS

THE LISTER INSTITUTE

THE Lister Institute of Preventive Medicine was founded in 1891, in honor of Lord Lister, to conduct scientific inquiries tending to prevent disease. The attachment of a hospital to the institute was specifically excluded by the articles of association, possibly to secure support from the many leaders of medicine who were on the staffs of existing hospitals, and possibly, also, because the intimacy of the union between clinical work and research was not sufficiently realized. By 1914 it had become plain that research could not be conducted with full advantage unless it went hand in hand with clinical opportunity. The experiences of the war drove home the lesson. Members of the staff of the Lister Institute and many other physicians and surgeons engaged on the battle-fronts, at base hospitals, or at military hospitals in this country, found that the immediate task of healing the sick not only advanced abstract knowledge, but set new problems for research. The governors of the institute have resolved unanimously to make the requisite changes in the articles of association. A convenient site for the proposed hospital lies adjacent to the institute. The council of medical research is the channel through which funds provided by the state are allotted to universities and research institutes, and it is to that body that the appeal is addressed. The proposed hospital need not be large. Its beds would be filled with selected cases, varying from time to time according to the specific inquiries that were being made. There would be relief to the general hospitals rather than rivalry with them. The experience of the Pasteur Institute in Paris and of the Rockefeller Research Hospital in New York shows that patients selected for a special purpose take an interest in their involuntary contribution to the advancement of knowledge, and rejoice that their own misfortunes may be the source of relief to others. They are certain of getting treatment even more considerate than that of a general hospital, and they have the advantage of not being the object-lessons of clinical teaching.—The London *Times*.

SCIENTIFIC BOOKS

Pasteur, The History of a Mind. By EMILE DUCLAUX. Translation by Erwin F. Smith and Florence Hedges.[1]

Both the French publication and this trans-

[1] A translation with annotations and additions of the original work, "Pasteur: Histoire d'un esprit," which appeared in 1896.

lation are unusual books. The conception is not that of a mere biography of Pasteur. It is, indeed, that in part, but Duclaux undertook the greater and subtler thing, an interpretation of the master mind, the dominant soul, the "histoire d' un esprit." His success in this is the thing which gave remarkable power to the French edition. While perhaps, as the translators state, something of the verbal force and charm of the original is inevitably lost in its transfer to English, yet there are in this translation some noteworthy gains which to the reviewer are fully compensatory.

In the first place, this English edition contains probably the finest and certainly the most complete series of portraits of Pasteur that has ever been published. There are fourteen of these, picturing him from early manhood to his later maturity. Pasteur's face and especially his eyes were unusually expressive and one traces in these portraits almost more surely, and certainly more quickly, than in the text the traits or moods belonging to the different periods of his life—the student, the crusader, the laureled victor.

Pasteur's life was dramatic. This was recently brought out with remarkable vividness by the French playwright Sacha Guitry.[2]

Duclaux in his "histoire d'un esprit" with a dramatist's skill selected successively the epochal events which crowded in succession through Pasteur's career from his apprenticeship days in l'école normale at Paris. These author's pictures serve also to portray vividly the direct bearing of Pasteur's early training in physics and especially in chemistry upon his later work on fermentation and other aspects of bacteriology. The reader is shown with almost kaleidoscopic abruptness first one picture then another, yet always with a dramatic unity since Pasteur is always the central figure. It is first Pasteur's works in crystallography, then in lactic and alcoholic fermentation, spontaneous generation, wines and vinegars, diseases of the silkworm, yeasts and brewing, etiology of microbial diseases, and finally the evolution of his work on viruses and vaccines including his studies on chicken cholera, rabies and the problems of immunity.

In this way the reader is given a synoptical survey of the period which marked the transition from the dominance of Liebig's chemical theories of fermentation to the full acceptance of the modern organic conception, *i. e.*, from the dominance of philosophical empiricism in biology and medicine to the full acceptance of the modern leadership of the laboratory investigator, trusting only the experimental method.

Duclaux's fitness for the task of portraying this with such remarkable vividness in so compact a volume is clearly shown in the senior translator's introduction of some thirty pages, which is a valuable contribution to the literature of biological history. It is prefaced by a portrait of Duclaux showing his alertly intellectual face at about the period 1897, when, upon the death of the master, he succeeded him as director of the Pasteur Institute, and is followed by another showing the careworn man in the last year of his life.

In this preface one traces Duclaux's intimate relationship with Pasteur from his enrollment as a student in the normal school at Paris in 1858 where "the master" was in charge of chemistry and the related scientific studies to the death of Pasteur in 1895—37 years. Here he and the other young laboratory assistants played their part as armor bearers in the heroic times of the early Pasteurian struggle. "The master was in the forefront of the conflict over molecular dissymmetry in crystals, the campaign on fermentations and the great battle over spontaneous generation." Duclaux, who was himself trained early as a chemist, analyzes Pasteur's mental attitude on these questions with keen facility. Nor can we overlook the fact that this English edition has been enriched throughout because of the like fitness of the translators for their task. Smith has always been chemically minded in his approach to his bacteriological problems. Moreover, while Duclaux is a remarkably well in-

[2] Sacha Guitry, Pasteur. Pièce en 5 actes. La Petite Illustration Théatrale. March, 1919.

formed chronicler and a sympathetic interpreter of Pasteur, it is doubtless true that Smith represents a type of mind and workmanship much more like that of Pasteur himself. He, like Pasteur, has fought the pioneer's battles and keenly relished the fray. One who knows this is prepared to find everywhere, in the introduction, in the translator's notes which are scattered through the book and especially in the annotations at the close a certain flavor quite other than Duclaux himself could impart.

The translation is avowedly addressed to the younger generations of American scientists who are liable to forget the dramatic conflicts through which were won the ways to the higher and freer conceptions which they have inherited. For this reason the book (and the translation better than the original) should serve admirably as a reading book about which a seminary may be conducted with students desiring to trace the history of biological thought during the last century. The reviewer proposes so to use it. For such purposes there is much gained through the addition by the translators at the close of the book of an annotated list of all persons to whom reference has been made in the text. Here as elsewhere there is evidence of those intimate, highly individualistic, personal touches through which Duclaux and Smith in combination have served to reflect so much of the dominant individualism of Pasteur.

L. R. JONES
UNIVERSITY OF WISCONSIN

NOTES ON METEOROLOGY

THE DISTRIBUTION OF MAXIMUM FLOODS

In an interesting paper read before the American Meteorological Society at its New York meeting, January 3, 1920, Professor A. J. Henry[4] analyzed the flood records of many of the streams of America and Europe with a view to determining their time and space distribution, and, if possible, any systematic or cyclic recurrence.

[4] "The Distribution of Maximum Floods," *ibid.*, pp. 861–866.

For the purpose of his discussion, Professor Henry has used the "average annual flood," which is defined as "the arithmetical mean of the annual floods for a number of years"; also the "maximum flood" which is that caused by excessive run-off when the rainfall is sufficient to raise the ground storage to a high level and thus saturate the soil, or when a warm rain falls on a snow cover; and finally, the "absolute maximum flood" which is the greatest reported for a given station. It is important to know what the absolute maximum flood magnitude is for a given place, and to know whether that maximum has been reached. Says Professor Henry:

> It can not be too strongly emphasized that the occurrence of the absolute maximum flood is usually conditioned upon the synchronism of certain climatic events which in themselves have no fixed law of occurrence. Very intense rainstorms are seldom long continued and of great extent. The heavy summer showers that occur in the United States being limited in area may cause an extraordinary flood in a small watershed, and doubtless many such floods occur in some part of the country annually. These extreme floods in small streams are completely absorbed as soon as they reach the trunk stream.

To the end of determining any relation between the absolute maximum and the average, the ratios of these two values have been tabulated for 45 of the principal rivers of the United States. The agreement of the various ratios is, as the author remarks, "better than was expected," amounting in general from 1.3 to 1.5; that is, the absolute maximum flood was 1.3 to 1.5 times the annual average. There are a number of ratios of greater magnitude, but, in most cases, this is accounted for either in the nature of the watershed, or the local conditions surrounding the gaging. Small ratios are found at places where overflow takes place easily and the river may greatly increase its cross-section.

There appears to be no cyclic distribution of floods but "that the dominating control is rainfall, and since there may be one, two or even three years of excessive rainfall, it follows that great floods may likewise occur

in successive years." Even for the same stream floods are a local phenomenon. An example of this is the record for Cincinnati and Pittsburgh, both on the Ohio River: the ten greatest floods are arranged in order of their magnitudes for the two stations (many other stations are tabulated in the paper), with the following result:

Station	Order of Magnitude									
	1	2	3	4	5	6	7	8	9	10
Cincinnati	1884	1913	1883	1907	1918	1898	1897	1901	1890	1882
Pittsburgh	1907	1884	1902	1913	1891	1861	1908	1862	1904	1897

Of the European rivers, the Danube, the Seine, the Neckar, the Rhine and the Main are investigated. The records of floods in these rivers extend back many centuries and would provide ample data for any periodic recurrence, but these also are found to be dependent upon the nature of the watershed and the rainfall distribution. The conclusions derived from the paper are:

1. The records of both American and European rivers show an average of 7 to 10 great floods per century.

2. Great floods are primarily due to precipitation, and that precipitation, in the form of rain, which produces floods may be of two distinct types, (*a*) so intense and widely distributed as to produce flooding regardless of antecedent conditions; (*b*) moderate rains continued intermittently for eight to ten days or more with antecedent conditions favorable to high run-off.

3. There does not appear to be an orderly progression in the magnitude of floods with the lapse of years; that is to say, the absolute maximum flood of any 100-year period is not necessarily greater than the absolute maximum flood for the preceding 100 years.

4. The magnitude of great floods with respect to the average annual flood, seems to increase in geometrical progression but apparently wholly regardless of the flow of time.

5. Great floods like great rainfalls are essentially a local phenomenon even for the same stream.

This paper was discussed by Mr. Robert E. Horton,[5] the hydrologic engineer, who is of the opinion that the occurrence of maximum floods is fortuitous and that the combinations of causes which may cause a maximum flood are very much more limited than the number of combinations which may cause ordinary floods.

NOTES

The spring announcement of MacMillan books contains the notice of a text-book on "Agricultural Meteorology," by Professor J. Warren Smith, of the United States Weather Bureau. This is the first text-book exclusively devoted to this subject and is certain to find a large demand, not only from agricultural colleges and universities, but also from the farmer and general reader, to whom it will be of practical value.

In the October, 1919, *Monthly Weather Review,* there are several short articles and abstracts on forecasting from local signs, such wind direction, clouds, pressure change, clouds, sky colors, and the scintillation of the stars. It is interesting to note the difference in character of the forecasting problems in Europe, where data is incomplete from the west, and in America, where more data is available but a greater diversity of local problems is encountered.

C. LeRoy Meisinger

Washington, D. C.

[5] *Ibid.*, pp. 866–867.

SPECIAL ARTICLES

A SIMPLE METHOD FOR TITRATING ELECTROMETRICALLY TO A DESIRED END POINT IN ACID-ALKALINE REACTIONS

Sörensen[1] and Clark and Lubs[2] have published detailed directions for the preparation

[1] Sörensen, "Über die Messung und Bedeutung der Wasserstoffionenkonzentration bei biologischen Prozessen," *Ergebnisse d. Physiologie,* 12, 393, 1912.

[2] Clark and Lubs, "The colorimetric determination of hydrogen ion concentration and its application in bacteriology," *Jour. Bacteriology,* 2, pp. 1, 109, 191, 1917.

of "standard mixtures" having a known hydrogen ion concentration or p_H value. These investigators established their formulas very precisely by the use of a potentiometer method employing a hydrogen electrode. According to Clark,[3] the p^H values in the freshly prepared mixtures may be considered reliable to a few hundredths of a p_H unit. Probably the widest application of these standard solutions is, in connection with color indicators, for comparisons with solutions having an unknown hydrogen ion concentration.

The fact that standard mixtures can readily be prepared, combined with the further fact that the hydrogen electrode is an appliance which is simple and convenient to use, leads to a very obvious suggestion. This is to utilize the hydrogen electrode as a means for comparison of an unknown with a standard solution. It should extend materially the usefulness of the standard solutions to which reference has been made.

We may suppose that we desire to titrate a solution of unknown p^H value to a definite hydrogen ion concentration. From the curves of Sörensen's article, or from the formulas of Clark and Lubs, we select the particular solution having a p_H value which corresponds to the point to which we desire to titrate. This solution is placed in one vessel with a hydrogen electrode, and connection is established between the standard solution and the unknown, in a second vessel, by means of a salt bridge of saturated potassium chloride, so that concentration potentials may be eliminated.[4] Another hydrogen electrode is placed in the solution of unknown concentration, and the two electrodes are connected through a tapping key and a galvanometer of high resistance. Appropriate protective resistance may also be put in this circuit. The process of titrating to the desired end point then consists merely of adding the titrating solution until, upon tapping the key, no deflection of the galvanometer is observed. The inference is that zero potential difference between the hydrogen electrodes is an indication of equal hydrogen ion concentrations of the two solutions. The supposition may be verified by putting both electrodes into one or the other of the solutions and noting whether the galvanometer deflection remains zero.

It may be pointed out that such a titration can be carried out in any solution in which a hydrogen electrode will maintain its equilibrium, regardless of color, turbidity, or other experimental conditions. The electrolytic portion of the galvanometer circuit will, in most cases, have a low resistance, which insures the desirable condition for sensitiveness of response of the instrument. The method has most of the advantages of the potentiometer method over the colorimetric methods, with the obvious exception that it can be used only for titrating and that the titration can be carried only to the end point which is determined by the standard solution. With the potentiometer it is possible, of course, not only to titrate to any end point but also to make a direct measurement, without titration, of the p^H value, whatever this may be.

It should be noted, finally, that in the titration described no calomel electrode is used, and that the accuracy with which the titration may be made is limited only by the accuracy with which the p_H value of the standard solution is known.

PAUL E. KLOPSTEG
LEEDS & NORTHRUP COMPANY,
PHILADELPHIA, PA.

[3] Private communication.

[4] The suggestion of using an agar-agar salt bridge to minimize diffusion effects (Falles and Vosburgh, *J. A. C. S.*, 40, 1306, 1918) seems a good one.

THE AMERICAN SOCIETY OF MAMMALOGISTS

THE second annual meeting of the American Society of Mammalogists was held May 3–5, 1920, in the American Museum of Natural History, New York City. Officers for the coming year are Dr. C. Hart Merriam, president; Mr. E. W. Nelson and Dr. Wilfred H. Osgood, vice-presidents; Dr. H. H. Lane, recording secretary; Dr. Hartley H. T. Jackson, corresponding secretary; Mr. J. W. Gidley, treasurer; Mr. N. Hollister, editor; Dr. Glover M. Allen, Dr. R. M. Anderson, Dr. Joseph Grinnell,

Dr. M. W. Lyon, Dr. W. E. Matthew, Dr. John C. Merriam, Mr. Gerrit S. Miller, Jr., Dr. T. S. Palmer, Mr. Edward A. Preble and Dr. Witmer Stone, directors.

A program of unusual interest was presented as follows:

MONDAY, MAY 3

Morning Session, 10 A.M.

Modern methods of mammalogical field work: VERNON BAILEY. Twenty-five minutes. Illustrated with apparatus.

Notes on the howling monkeys and other mammals from British Guiana: WILLIAM BEEBE. Twenty minutes. Illustrated with lantern slides.

Fetuses of the Guiana howling monkey: ADOLPH H. SCHULTZ. Twenty minutes. Illustrated with lantern slides.

Some life histories of African mammals gathered during the Congo expedition: H. LANG. Forty minutes. Illustrated with lantern slides.

Notes on the mammals of Mount Rainier, Washington: WALTER P. TAYLOR. Thirty minutes. Illustrated with lantern slides.

MONDAY, MAY 3

Afternoon Session, 2 P.M.

Resemblances and contrasts between zoological and paleontological research in mammalogy. Desirability of uniform standards and systems in classification, in description, in measurement, in reasoning: HENRY FAIRFIELD OSBORN. Fifteen minutes.

On the history of the gray squirrel: ERNEST THOMPSON SETON. Thirty minutes.

The Roosevelt Wild Life Forest Experiment Station: CHARLES C. ADAMS. Ten minutes.

Business session, 3 P.M. (Open only to members.)

MONDAY, MAY 3

Evening Session, 8 P.M.

Notes on the sea lion (Otaria jubata) of the Peruvian coast: ROBERT CUSHMAN MURPHY. Thirty minutes. Illustrated with lantern slides and motion pictures.

Preliminary results of the second Asiatic expedition to China and Mongolia: ROY CHAPMAN ANDREWS. One hour. Illustrated with lantern slides and motion pictures.

TUESDAY, MAY 4

Morning Session, 10 A.M.

The mammals of Jamaica: H. E. ANTHONY. Thirty minutes. Illustrated with lantern slides.

The Calvert Miocene formation and some of its mammals: WILLIAM PALMER. Thirty minutes. Illustrated with lantern slides.

On some early states in the evolution of mammalian dentition: WILLIAM K. GREGORY. Forty minutes. Illustrated with lantern slides.

Some scattered observations about narwhals: MORTON P. PORSILD. Ten minutes.

Beginnings of the placental mammals: W. D. MATTHEW. Twenty-five minutes. Illustrated with lantern slides.

TUESDAY, MAY 4

Afternoon Session, 2 P.M.

A dissection of a pigmy sperm whale (Kogia): C. L. CAMP AND J. P. CHAPIN. Fifteen minutes. Illustrated with lantern slides.

(a) Notes on New England. (b) Bison remains in New England. (c) Exhibition of specimens of Myotragus, the remarkable Pleistocene goat of the Balearic Islands: GLOVER M. ALLEN. Twenty-five minutes. Illustrated with photographs and specimens.

Blue-fox farming and the maintenance of the fur supply: NED DEARBORN. Thirty minutes.

The fate of the European bison: T. S. PALMER. Twenty minutes.

Saving the Yellowstone elk herd: E. W. NELSON. Twenty minutes. Illustrated with lantern slides.

WEDNESDAY, MAY 5

Members met at The American Museum of Natural History at 9:30 in the morning, and went to the Bronx Park, where they were conducted through the park and entertained at luncheon as the guests of the New York Zoological Society.

HARTLEY H. T. JACKSON,
Corresponding Secretary

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, JULY 9, 1920

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE SCIENTIFIC BASIS OF THE ILLINOIS SYSTEM OF PERMANENT SOIL FERTILITY[1]

IT is practically impossible to cover, in an adequate way, the scientific principles underlying the Illinois system of permanent soil fertility in the brief space of time allotted me on the program. Nevertheless, I shall point out the fundamental principles underlying the system without attempting to illustrate the points made by definite data as I should like to do.

Eighty years ago Liebig, the father of agricultural chemistry, made the following statement:

> Agriculture is, of all industrial pursuits, the richest in facts, and the poorest in their comprehension. Facts are like grains of sand which are moved by the wind, but principles are these same grains cemented into rocks.

The great contribution made to American agriculture by the late Dr. Hopkins was the gathering together, classifying, interpreting and unifying, by his own investigations the known facts of agriculture, into a definite whole as practised and taught by him in the Illinois system of permanent soil fertility.

Many of the facts upon which the Illinois system rests have been known for many years and even centuries and have been developed by other men in other institutions and in other times. It remained, however, for Dr. Hopkins to bring together and unify these isolated facts into a definite workable system and by his own investigation to demonstrate clearly that the system could be understood and used by the average farmer on his own farm with very profitable results. In his interpretation of the facts upon which the system is based, all men have not agreed and some even still do not agree with him but the system rests on the

[1] An address given at the Hopkins Memorial, January 22, 1920

sure foundation of facts supported by an abundance of experimental data now available from the fields and laboratories of the University of Illinois operated under his direction.

The Illinois system recognizes clearly that there are six positive factors of crop production. These factors of crop production may be briefly indicated by single terms as the seed, temperature, moisture, light, a home for the plant, and food for its use. These factors are all of equal importance in the production of crops. Not all of the factors, however, are susceptible of equal control. It is impossible, for example, to change the temperature conditions of winter so as to make that season suitable for crop production, and the practical means available for modifying the temperature conditions of the soil during the growing period of the crop are very limited. Of all the factors of crop production, the food factor is completely within the control of the farmer. It is fully possible for him to completely change, in an economic way, the amount of food available for the plant within the soil. It is frequently true, also, that the food supply is the limiting factor of crop production, especially under humid conditions such as prevail in Illinois.

The Illinois system of permanent soil fertility, therefore, deals in a large measure with this factor of crop production. There are 10 essential elements of plant food and these are carbon, oxygen, hydrogen, iron, sulfur, calcium, magnesium, potassium, nitrogen and phosphorus. All of these ten elements of plant food are of equal importance in crop production, for, in the absence of any single one, the plant can not function normally and produce a good yield of its kind. Not all of the plant foods, however, are within the control of the farmer, while some of them are obtained from natural sources in sufficient quantities so that they never limit crop yields.

Carbon and oxygen are obtained by the plant from the small amount of carbon dioxide of the atmosphere, and this supply is constantly being replenished from natural sources. Hydrogen is obtained by the plant from the soil moisture which in turn is being constantly replenished by the rainfall under humid conditions. The plant consists largely of these elements of plant food, their compounds forming approximately 95 per cent. of all plant parts. These three elements of plant food are constantly being replenished in the soil or air from natural sources, and the farmer, therefore, need not concern himself further with them.

Iron is used by the plant in such extremely minute quantities, and the supply in the soil is so large, that it need never be added to the soil as a plant food. While the plant food requirements for sulfur are comparable in many respects with those for phosphorus, sulfur is constantly being added to the soil from natural sources in quantities more than sufficient to meet the needs of the plant for food. For these reasons, these two elements need no special consideration in a permanent system of soil fertility.

There remain, therefore, five elements of plant food which must receive careful consideration by the farmer in any system of permanent soil fertility which may be proposed. These elements are calcium, magnesium, potassium, phosphorus and nitrogen. A system which assumes to be permanent must provide for the return to the soil of those elements of plant food removed by the crop, unless they are present in the soil in unusual quantities sufficient to provide for the maximum production of crops for indefinite periods of time. The Illinois system considers and makes such provision for these five elements of plant food.

The inorganic plant foods, calcium, magnesium, potassium and phosphorus, are removed by the plants in comparatively large quantities. An ordinary rotation of wheat, corn, oats and clover would remove, for the maximum production of crops, 77 pounds of phosphorus, 320 pounds of potassium, 68 pounds of magnesium and 168 pounds of calcium, and these substances are obtained by the plant from the soil and there is no other possible source unless materials containing them are added to the soil. It is, therefore, of fundamental importance to know the amounts of these materials which occur in the soil and

to determine their relation to the requirements of the plant.

Various chemical methods have been proposed from time to time for analyzing the soil. Most of these have been based upon the fantastic claim that they determine the "available" plant food in the soil. Dr. Hopkins early realized the futility of such a claim, and concerned himself only with the determination of the total amounts of plant food within the soil. He used chemical analysis as a means of taking an invoice of these substances within the soil, just as the merchant takes an invoice of the goods upon his shelves. Whether or not the farmer makes the proper use of this material, depends largely upon him and the kind of farming he carries on, just as it depends upon the business ability of the merchant whether or not his business is successful, but in both cases an accurate invoice of stock with which he must work is as absolute a necessity for the farmer as for the business man.

The chemical analysis of the soils of Illinois, carried on with this idea in mind, soon showed a marked variation in the amounts of the various essential plant foods present in the soil. The brown silt loam of Campaign county, for example, contains over 9,000 pounds of magnesium, 10,000 pounds of calcium, 35,000 pounds of potassium, and only 1,000 pounds of phosphorus in the plowed surface soil. As measured by this accurate soil invoice, phosphorus is the most limited element in the soil, and, as measured by the crop requirements also, it is found that phosphorus is the most limited of plant foods in this typical corn belt soil. There is sufficient calcium present, for example, for the production of a 100 bushel crop of corn for 90 centuries. There is sufficient magnesium for 13 centuries, sufficient potassium for 18 centuries, while there is sufficient phosphorus for only 62 years, even if it could be utilized by the plant, and provided a maximum crop of 100 bushels of corn were produced and all material except the grain is returned to the soil. These illustrations are typical, and are very significant in emphasizing the importance of phosphorus to crop production, and indicate clearly its marked deficiency in the soil.

The fifth element, nitrogen, is very important. It is used by the plant in large quantities, and when purchased upon the markets of the world it is the highest priced of all materials. A hundred pounds of nitrogen are required for the production of 100 bushels of corn, and nitrogen at present is selling for $.30 a pound. The maintenance of the nitrogen supply of the soils is, in the language of Dr. Hopkins, "the most important practical problem confronting the American farmer." It is quite evident that the farmer can not afford to purchase commercial nitrogen for the production of his common farm crops. A tax on corn of $.30 per bushel for this purpose is absolutely prohibitive. The farmer must, therefore, depend upon legume nitrogen which is obtained by legumes such as clover, alfalfa, soybeans, etc., by the aid of symbotic bacteria from the inexhaustible supply in the air, provided the soil conditions are favorable to their growth and development. It is, therefore, necessary that a legume occur in the rotation and that the legume hay or chaff produced must be carefully conserved and returned to the soil, either as farm manure or green manure crops. It is of importance, also, that the utmost use be made of legume cover crops grown in connection with the production of wheat, and other cereals, and in the development of this use of legume cover crops the research work of Dr. Hopkins is particularly outstanding. Sweet clover was a favorite crop with him for this purpose, and he was among the first to call attention to its great possibilities. Unfortunately, legumes, so essential for soil improvement, can not be successfully grown on many soils in Illinois, as they now exist, because of the acid soil conditions which frequently absolutely prevent their growth.

A limestone soil is a rich soil, is an age old truth. Soils which have become famous everywhere for their persistent fertility are limestone soils. This is true of the soils of the far western United States, the bluegrass regions of Kentucky, the valley of the Nile, the black soils of India and Russia. Limestone,

therefore, is of fundamental importance in soil fertility. Unfortunately, limestone is easily soluble in carbonated water, and of all soil constituents probably is most readily lost in the drainage water. Humid soils, as a rule, are, therefore, deficient in this essential constituent, and the first principle of soil fertility is that limestone must be added to those soils in which it is not already present. The limestone is added primarily for the purpose of creating conditions favorable to the growth of the necessary legume crops, although it also has a markedly favorable action in increasing the yields of the cereal crops in the rotation.

There are various forms and kinds of limestone materials available for use, but the work of Dr. Hopkins has clearly demonstrated that the most economic form to use is the finely ground natural limestone—the normal material occurring in the soil. The abundance of data obtained by him on the various experimental fields for the use of finely ground limestone, particularly in southern Illinois, furnish now the best information the world affords regarding the great benefit from the use of limestone for the production of common farm crops. The addition of limestone to the soil not only corrects the acid conditions but also provides the necessary calcium and magnesium as plant foods.

In most normal soils, such as the brown silt loam of the corn belt, potassium occurs in the soil in such large quantities that it will last for the maximum production of crops for indefinite periods of time and so, in the case of potassium, the problem of the farmer is not one of addition to such soils, but is one of liberation from the insoluble compounds contained in soil. A normal soil, well supplied with fresh decomposing organic matter as provided in the grain or livestock system of farming, will provide sufficient potassium to meet the requirements of crops for this element; and the experimental results, obtained from the various experimental fields for addition of potassium, have shown clearly that it not only does not pay for itself, when used on such soils, but gives little actual increased yield.

There are certain abnormal types of soil on which potassium is absolutely essential. Such soils are peaty soils and soils deficient in organic matter. On peaty soils, potassium is the limiting element of plant food and is often the limiting factor of crop production. The addition of potassium, therefore, to such soils is an absolute necessity. On soils deficient in organic matter, such as many of those occurring in southern Illinois, potassium may be used with profitable results until the soil has been built up in its organic matter content.

On normal soils, phosphorus is frequently the limiting element of crop production. There are various forms of phosphorus available for use such as barnyard manure, steamed bone meal, basic slag, acid phosphate and raw rock phosphate. Of the various forms available, the abundant experimental data, obtained from the experimental fields maintained by the university, prove conclusively that the finely ground raw rock phosphate may be used with considerable profit and, for economic reasons, this form of phosphorus is regarded as the most desirable form to use although there may be special conditions under which some of the other forms may be used.

There are two well-defined types of farming occurring in Illinois. These are the grain system of farming and the livestock system of farming. Both of these are perfectly legitimate, proper, necessary and profitable systems of farming, and it is possible and feasible to provide means whereby the fertility of the soil may be maintained on a permanent and profitable basis in either case. Both types of farming are absolutely necessary and essential to the development of the highest stage of civilization, for as long as man demands bread, butter, meat and milk, and until we are willing that our standard of living shall be lowered, both of these types of farming must exist. It is essential, therefore, that provision be made whereby the fertility of the soil may be maintained in order that grain and livestock farming may become permanent institutions in the land. The Illinois system of permanent soil fertility recognizes this fact, and makes provisions for the maintenance of

fertility on both the livestock and the grain farm. In either type of farming, limestone and phosphate must be used so as to permit the growth of legumes so essential in soil improvement and also in the feeding of livestock.

While Dr. Hopkins took particular pains to point out and emphasize the possibility of maintaining the fertility of the soil on the grain farm on a permanent and profitable basis, he also made important contributions to our knowledge regarding methods of maintaining the fertility of the livestock farm. The teachings of Dr. Hopkins in this respect are of tremendous importance since they provide for the extension of livestock farming to large areas where heretofore the proper feeds could not be produced. On all of the experimental fields just one half of the work is devoted to the maintenance of soil fertility in livestock farming. The livestock farmers of Illinois should have a deep sense of gratitude to Dr. Hopkins for his work in their behalf.

If a system is to be permanent, the materials removed from the soil must be returned, at least in the proportion in which they are removed by natural processes, including the amount removed by the crop and the amount lost in the drainage water. This would seem to be such a simple axiomatic truth that it need not be dwelt on; however, it is a point which must be constantly emphasized again and again. The use, therefore, of two or three hundred pounds of an ordinary commercial fertilizer of a 2-10-2 grade, which adds only five or six pounds of nitrogen, must act purely as a soil stimulant. For, if increased crops are obtained by its use, they can be obtained only at the expense of the nitrogen already in the soil, since the requirement for a 100 bushel crop of corn is 100 pounds of nitrogen. The Illinois system of permanent soil fertility, therefore, condemns in unmeasured terms the use of such soil stimulants, among which must be classified ordinary mixed commercial fertilizers and gypsum.

In the briefest way possible, the very essential points underlying the Illinois system of permanent soil fertility have thus been merely touched upon. But it is the desire to emphasize at this point that the Illinois system of permanent soil fertility rests upon a sane and safe scientific basis, and, because it makes abundant use of cheap, natural, raw, products, as legume nitrogen and finely ground materials such as limestone and rock phosphate, it is both a permanent and profitable system of soil fertility. This is the heritage to Illinois farmers left by him in whose memory we have met here to-day.

Robert Stewart
University of Illinois

RADICALISM AND RESEARCH IN AMERICA

Investigators who are concerned as to the possibility of adequate facilities for research being maintained by popular governments, or who doubt whether a republic working through democratic institutions like our National Research Council can equal the scientific attainments of autocratic Germany, will derive much encouragement from a review of American history. Prominent among the agencies which, in addition to privately endowed institutions, have supported the prosecution and publication of scientific research in this country are Academies of Science, State Universities, Land Grant Colleges and Agricultural Experiment Stations, Federal Department of Agriculture, Coast and Geodetic Survey and the State and National Geological Surveys. In many cases the inception or period of most marked development of these institutions has been closely linked with striking political developments. Without presenting any unpublished data the present paper aims to assemble some of the facts which seem significant in this connection.

Undoubtedly the most radical document ever adopted by an American national assembly was the Declaration of Independence. The active members of the committee appointed to draft this instrument were Franklin, Adams, and Jefferson, each of whom made a distinct contribution to the advancement of scientific foundations in America.

Franklin's fame as a scientist, as a diplomat, and as leader of the radical faction in our

constitutional convention make comment on these points unnecessary. Of special interest here is his activity in founding our first academy of science.[1] As early as 1743 Benjamin Franklin issued his circular entitled "A proposal for promoting useful knowledge among the British plantations in America," in which he urged the establishment of a society to be called "The American Philosophical Society." From this Society and another organized in 1766, of which Franklin was first president, grew in 1769 The American Philosophical Society of to-day. Of this society Franklin was president from its organization until his death and Dr. Benjamin Rush, one of the signers of the Declaration of Independence, was one of the secretaries. The American Philosophical Society began in 1771 the publication of the *American Philosophical Transactions* and soon assumed national importance and assisted in making Philadelphia for many years "the metropolis of American Science."[2]

To John Adams, who in 1776 seconded the famous resolution of Richard Henry Lee that "these colonies are, and of right ought to be free and independent states" and bore the foremost place in the debate on the adoption of the Declaration of Independence, our second Academy of Science owes its origin. The circumstances which led to Adams' deep and lasting interest in scientific foundations, and his part in founding the American Academy of Arts and Sciences which was incooperated by the legislature of Massachusetts in 1780 and published its first memoirs in 1785, are detailed by Goode.[3] One of the original members of the American Academy of Arts and Sciences was Levi Lincoln, Attorney-General of the United States under Jefferson.

When Washington became president these two societies were the only scientific organizations in this country and it is worthy of note that the president, vice-president and the secretary of state in that first administration were all fellows of the American Philosophical Society. The efforts of Washington himself and later of Madison to establish a national university might well be mentioned here but for the fact that the national university which was urged in presidential messages over a century ago is not yet an accomplished fact.

The activities of the author of the Declaration of Independence in behalf of science and education are well known. In the opinion of Goode[4]

> no two men have done so much for science in America as Jefferson and Agassiz—not so much by their direct contributions to knowledge as by the immense weight which they gave to scientific interests by their advocacy.

In 1782 appeared Jefferson's "Notes on the state of Virginia,"[5] the first comprehensive treatise on the natural history and resources of one of the states, and the precursor of the numerous state surveys since issued. When in 1797 Jefferson came to Philadelphia to be inaugurated vice-president[6] he brought with him a collection of the fossilized bones of some large quadruped and the manuscript of a memoir upon them, which he read before the American Philosophical Society. "The spectacle," remarks Luther,[7] "of an American statesman coming to take part as a central

1 Goode, George Brown, "The Origin of the National Scientific and Educational Institutions of the United States," Rpt. U. S. Nat. Mus., 1896–97, p. 266, 1901.

2 Goode, George Brown, *op. cit.*, p. 268.

3 Goode, George Brown, *op. cit.*, p. 268–269.

4 Goode, George Brown, "The Beginnings of Natural History in America," Rpt. U. S. Nat. Mus., 1896–97, p. 394, 1901.

5 The first edition, 1782, was published in Paris and but few copies were printed. The preface to the second edition, London, 1787, states with reference to the Paris edition "the subjects are all treated imperfectly; some scarcely touched on . . . They are now [1787] offered to the public in their original form and language."

6 Goode, George Brown, "The Origin of the National Scientific and Educational Institutions of the United States," Rpt. U. S. Nat. Mus., 1896–97, p. 280, 1901.

7 Luther, F. N., "Jefferson as a Naturalist," *Mag. Amer. Hist.*, Vol. 13, No. 4, p. 386–387, April, 1885.

figure in the greatest political ceremony of our country and bringing with him an original contribution to the scientific knowledge of the world, is certainly one we shall not soon see repeated."

Jefferson's presidency Goode[8] calls the "most memorable in the history of American science." Not only was the president actively engaged in paleontological research, using one of the unfinished rooms of the White House[9] for the storage and display of some 300 specimens of fossil bones from the famous Big Bear Lick,[10] but his administration was marked by the inception of the system of scientific surveys of the public domain and the organization of the Coast Survey. Jefferson's part in originating and supporting the Lewis and Clarke expedition has been detailed by True.[11] And who ever originated the idea of a Coast Survey it is certain that the early organization of the survey itself was due to Jefferson.[12]

Nor was Jefferson's interest in scientific foundations limited to those which he originated and could further in some large way. When, a little over a century ago, Benjamin Silliman launched *The American Journal of Science* he was much concerned as to whether a sufficient subscription list could be maintained. Among those to whom he wrote asking for subscriptions was Jefferson, then in his seventy-fifth year. How Jefferson's reply, here quoted from Dana's article[13] must have heartened the first editor of what is now our oldest scientific journal, can best be appreciated, perhaps, by those who are still struggling with the question of adequate support for American scientific publications.

MONTICELLO, April 11, '18

Sir: The unlucky displacement of your letter of Mar 3 has been the cause of delay in my answer. altho' I have very generally withdrawn from subscribing to or reading periodical publications from the love of rest which age produces, yet I willingly subscribe to the journal you propose from a confidence that the talent with which it will be edited will entitle it to attention among the things of select reading for which alone I have time now left. be so good as to send it by mail, and the receipt of the 1st number will be considered as announcing that the work is commenced and the subscription money for a year shall be forwarded. Accept the assurance of my greatest esteem and respect. TH. JEFFERSON

PROFESSOR SILLIMAN.

If not his most notable contribution to science and education, the foundation of our first state university was apparently the one nearest Jefferson's heart. His part, when well over seventy, in the foundation of the University of Virginia as originator, as organizer, as architect and as first head of the institution has been too well told[14] to warrant repetition. His special interest in the teaching of science in this university has been

[8] Goode, George Brown, "The Origin of the National Scientific and Educational Institutions of the United States," Rpt. U. S. Nat. Mus., 1896–97, p. 280, 1901.

[9] Merrill, George P., "Contributions to the History of American Geology," Rpt. U. S. Nat. Mus., 1903–04, p. 213, 1906.

[10] Such scientific tendencies were the object of much criticism in the more conservative portions of the country. The following lines from the "Embargo" written by William Cullen Bryant (when a boy of 13) probably represents public opinion in his locality.

Go, wretch, resign the presidential chair
Disclose thy secret measures, foul or fair,
Go, search with curious eyes for horned frogs,
'Mid the wild wastes of Louisianan bogs,
Or where the Ohio rolls his turbid stream
Dig for huge bones, thy glory and thy theme.

[11] True, Rodney H., "Thomas Jefferson in Relation to Botany," *Sci. Mo.*, Vol. 3, No. 4, pp. 354–357, October, 1916.

[12] Goode, George Brown, "The Origin of the National Scientific and Educational Institutions of the United States," Rpt. U. S. Nat. Mus., 1896–97, p. 293, 1901.

[13] Dana, Edward S., "The American Journal of Science from 1818 to 1918," *Amer. Jour. Sci.*, Sr. 4, Vol. 46, No. 271, p. 30, July, 1918.

[14] Adams, Herbert B., "Thomas Jefferson and the University of Virginia," p. 308, pl. —, Washington, D. C., 1888. (U. S. Bur. Educ. Circ. Inform. 1.) True, Rodney A., "Thomas Jefferson in Relation to Botany," *Sci. Mo.*, Vol. 3, No. 4, pp. 345–360, port., October, 1916.

emphasized by True,[15] and that in Jefferson's mind at least, political radicalism and interest in higher education were clearly joined may be judged from the epitaph he himself prepared.

Here was buried Thomas Jefferson, author of the Declaration of Independence, of the statute of Virginia for religious freedom and father of the University of Virginia.[16]

If this subject were pursued into the field of state and local history much relevant data could be presented. Merrill[17] traces "the beginning of the work which resulted in the establishment of the State survey" in New York to a course of lectures on natural history delivered by Amos Eaton before the State Legislature in Albany during April, 1818, on the invitation of Governor DeWitt Clinton. Clinton, while best known historically for his work in behalf of the Erie Canal, was active in securing the abolition of slavery in New York state and in perfecting a system of free public schools and was the author of a series of letters signed "A Countryman" in reply to the "Federalist."

Edward Hitchcock's Survey of Massachusetts (1830–1833), which Merrill refers to[18] as marking "an epoch in American geological work, since it brought to a successful conclusion the first survey of an entire state at public expense," was also a result of the interest of a radical governor, Levi Lincoln, (son of the Lincoln mentioned above) who recommended the survey and Professor Hitchcock's appointment. Governor Lincoln is known in the history of his state as the first governor to exercise the veto power, and as the leader of the minority in the Massachusetts State Legislature who protested against the Hartford convention of 1814.

Nor was the fostering of science and education wholly the concern of individual radicals at this period. For hardly had the Democratic majority in Maine effected the separation of the state from Federalist Massachusetts (1820) than the State Legislature made an annual grant of $1,000 to aid in maintaining an institution which was to give mechanics and farmers "such scientific education as would enable them to become skilled in their professions."[19] This institution was incorporated as the Gardiner Lyceum and opened January 1, 1823.

The greatest radical movement after the Revolution was that which resulted in the abolition of slavery. Of those whose names have already appeared in this sketch, Jefferson and Clinton were conspicuous advocates of abolition. The first prominent opponent in Congress of the extension of slavery was probably John Quincy Adams. One is not surprised to learn that this sturdy individualist who changed his political affiliations at will and maintained an influential position in Congress for many years, independent of party and who refused to be silenced by the "gag rule" of 1837 was deeply interested in science and its advancement. As outlined by Goode[20] he revived Washington's National University project, worked for a national astronomical observatory, was actively interested in the foundation of the Smithsonian Institution and considered his most important achievement to be the Report on Weights and Measures prepared for Congress in 1818. Of this he was justly proud for it was a very admirable piece of scientific work. He found the presidency of the American Academy of Arts and Sciences so congenial to his tastes and sympathies that he did not hesitate to say that he prized it more highly than the chief magistracy of the nation.

It was during his term as president that the consuls in various parts of the world were instructed to send to the Department of State rare seeds and plants for distribution, and about the same time a Botanical Garden was

15 True, Rodney H., *op. cit.*, p. 359.

16 True, Rodney H., *op. cit.*, p. 360.

17 Merrill, George P., *op. cit.*, p. 234.

18 Merrill, George P., *op. cit.*, p. 307.

19 True, A. C., "Agricultural Education in the United States," U. S. Dept. Agr. Yearbook, 1899, p. 163, 1900.

20 Goode, George Brown, "The Origin of the National Scientific and Educational Institutions of the United States," Rpt. U. S. Nat. Mus., 1896–97, pp. 302–311, 1901.

established in Washington. These measures proved, according to True[21] to be the "germs from which has grown the United States Department of Agriculture."

The movement against slavery resulted in the election in 1854 of a majority in the House of Representatives of men pledged to oppose the extension of slavery. Among the members of the Republican majority which gained control of the House in 1855 was Justin S. Morrill, who in December, 1857,[22] introduced a bill "donating public lands to the several States and Territories which may provide colleges for the benefit of agriculture and mechanic arts." This bill, though finally passed by Congress, was vetoed by the reactionary Buchanan. A similar bill, however, introduced by Mr. Morrill in December, 16, 1861, was passed by both Houses and approved by Abraham Lincoln July 2, 1862, the very day when McClellan's army began its retreat from the Peninsula after the battle of Malvern Hill. Although under the provisions of the act ten per cent. of the fund might be expended for "the purchase of lands for sites and experimental farms,"[23] the chief significance of the Morrill Act for research lies in its relation to the subsequent and closely connected development of experiment stations.[24] After the fund which had been established by the sale of the landscript donated to Connecticut under the Morrill Act had been given to the Sheffield Scientific School of Yale University in 1863, a professor of agriculture was appointed. Under Samuel W. Johnson, professor of theoretical and agricultural chemistry and William H. Brewer, professor of agriculture in the Sheffield Scientific School, experimental work for the benefit of agriculture was carried on. And True[24] does not hesitate to ascribe to these men and their pupils more than to any other single cause, the recognition of the importance of the establishment of agricultural experiment stations.

Professor W. O. Atwater, the first director of the first regularly organized experiment station in this country, was among the students trained in this school. From such a beginning grew the experiment stations of the United States, first regularly organized under the Hatch Act, approved by President Cleveland, March 2, 1887.

Although the chief energies of Lincoln's administration were turned toward the prosecution of our Civil War, Congress passed a bill establishing a Department of Agriculture, an act which became law by approval of President Lincoln on the 15 of May, 1862.[25]

Even during the trying days of reconstruction members of the first Republican Congress did not neglect scientific investigation and "in the spring of 1867 Hayden [F. V.] acting under the direction of the General Land Office, and with an appropriation from Congress amounting to $5,000, began his work as U. S. geologist in Nebraska, and in so doing laid the foundation for the U. S. Geological Survey"[26] which "for breadth of scope and financial resources, is without counterpart in the world's history of science."[27]

To attempt to maintain that science can be encouraged only under popular governments would be impossible, even if desirable. The history of science and education in the United States does indicate, however, that in America there has been no antagonism between popular government and government supporting research. Radicals in America have never raised the cry "The Republic has no need of

[21] True, A. C., "Education and Research in Agriculture in the United States," U. S. Dept. Agr. Yearbook, 1894, p. 99, 1895.

[22] True, A. C., 1900, *op. cit.*, p. 167.

[23] True, A. C., 1895, *op. cit.*, p. 96.

[24] True, A. C., 1895, *op. cit.*, pp. 105–106.

[25] In calling attention to the fact that the bills creating our Land Grant Colleges and Department of Agriculture, were signed by the author of the Emancipation Proclamation and Gettysburg address, one is tempted to mention that the granting of a charter by Congress to the United States Agricultural Society was opposed in the Senate in 1855 by Jefferson Davis. (True, A. C., *op. cit.*, 1895, p. 92.)

[26] Merrill, George P., "Contributions to the History of American Geology," Rpt. U. S. Nat. Mus., 1903–04, p. 592, 1906.

[27] Merrill, George P., *op. cit.*, p. 551.

savants."[28] On the contrary those periods in which political radicalism has been most marked have been those in which science received most liberal governmental aid and encouragement.

NEIL E. STEVENS
BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

SCIENTIFIC EVENTS

BIOMETRIC AND EUGENIC LABORATORIES AT UNIVERSITY COLLEGE, LONDON

THE *British Medical Journal* states that the new building given by Sir Herbert Bartlett, Bt., to the Department of Applied Statistics formed by the Drapers' Company and Galton Laboratories at University College, London, was opened on June 4 by the Minister of Health. The Drapers' Company Biometric Laboratory was instituted under the direction of Professor Karl Pearson in 1904; it is a research laboratory and training school in the modern mathematical theory of statistics. The Galton Laboratory for National Eugenics was instituted in 1905, and was, by Sir Francis Galton's wish, associated with the other. When Sir Francis Galton died in 1911 he bequeathed a large part of his estate to found the Galton professorship, and Professor Karl Pearson was appointed to the chair. At the same time the senate of the university appealed for funds for building and equipment, and Sir Herbert Bartlett came forward with an offer to provide the building on a site at the northwest front of the college. During the war the new building was used as a military hospital, and only now has the department been able to take full possession. On the ground floor of the building is a large museum for the illustration of heredity, statistical processes, and social problems, a lecture theater, a room for the exhibition of Galton relics and apparatus, and an anthropometric laboratory. On the first floor there are laboratories, a library, and a common room, and on the second a photographic studio, a large room for biometric workers in craniometry, and rooms for archives and instruments. The apartments in all number over twenty, and it was announced that a site has been reserved for extension, which will include animal breeding accommodation.

The vice-chancellor of the university, Dr. Russell Wells, who presided over the opening ceremony, said that statistics, properly understood, was one of the most difficult and advanced mathematical studies, but it was a dangerous weapon in the hands of the partially educated. Medicine in particular had suffered greatly from its misuse. The method introduced by Professor Karl Pearson would make it possible to arrive at the proof of many complicated medical problems. In sketching the history of the department, he reminded the audience of Florence Nightingale's well-known interest in statistics, and of her desire to found a professorship of applied statistics at University College, for which, however, her means were not sufficient. It was not until the generous provision of the Drapers' Company was made that a start became possible.

Dr. Addison gave an appreciation of the value of statistics which he had discovered when minister of munitions. There were few branches of public service with greater scope for the trained statistician than that of communal health, but here and in social science many statistics had been of a thoroughly incomplete and unsatisfactory nature. He commended to the support of the public the further appeal which University College was making to maintain and complete the equipment of the new building.

The provost, Sir Gregory Foster, expressed the thanks of those present to Dr. Addison. The thanks of the university to Sir Herbert Bartlett for his gift were expressed by the vice-chairman of the college committee, Dr. J. Bourne Benson. Professor Karl Pearson said

[28] When during the "Reign of Terror" Lavoisier was condemned to death, a petition was presented to the rulers that his life might be spared for a few weeks in order that he might complete some important experiments, but the reply was "The Republic has no need of savants." (Goode, George Brown, "The Origin of the National Scientific and Educational Institutions of the United States," Rpt. U. S. Nat. Mus., 1896–97, p. 324, 1901.)

that one English monarch for whom he had a reverential regard was Henry VI. He saluted his statue whenever he crossed the lawn at King's College, Cambridge. In the fifteenth century it was possible to spend money on wars in France or on the founding of monasteries, but Henry chose to found King's College. And to encourage learning was still the surest way to secure that one's name was held in honor through grateful generations.

FISHERIES OF THE GULF STATES, 1918

DURING the past year the Bureau made a statistical canvass of the fisheries of the South Atlantic and Gulf States for the year 1918, and the returns for the latter section have recently been compiled and sent to press as Statistical Bulletin No. 470. The last previous canvass of these states by the Bureau was for the year 1902, and a later canvass was made by the Bureau of the Census for the year 1908. The statistics for the Gulf States cover the fisheries of the west coast of Florida and Alabama, Mississippi, Louisiana and Texas. In 1918 there were 14,888 persons employed in the fisheries of these states; the investment amounted to $6,537,859; and the products aggregated 130,923,583 pounds, having a value of $6,510,310. Of this total, the west coast of Florida produced 54,753,639 pounds, valued at $3,420,363; Alabama, 5,609,219 pounds, valued at $230,567; Mississippi, 20,592,089 pounds, valued at $762,770; Louisiana, 24,953,876 pounds, valued at $1,419,367; and Texas, 25,014,760 pounds, valued at $677,243. Some of the more important species taken in these states were black drum, 2,011,288 pounds, valued at $49,140; catfish, 851,265 pounds, valued at $40,072; croaker, 714,692 pounds, valued at $43,446; groupers, 5,935,825 pounds, valued at $235,406; menhaden, taken mostly in Texas, 14,392,920 pounds, valued at $109,939; mullet, including roe, 28,641,364 pounds, valued at $1,318,379; redfish or red drum, 2,986,180 pounds, valued at $175,109; red snapper, 9,429,802 pounds, valued at $609,312; Spanish mackerel, 3,494,845 pounds, valued at $215,197; squeteagues or "sea trouts," 4,960,738 pounds, valued at $414,593; shrimp, green and dried, 27,142,999 pounds, valued at $1,098,427; and oysters, 23,754,465 pounds, or 3,393,495 bushels, valued at $1,106,725. The output of sponges amounted to 452,188 pounds, valued at $725,155.

Compared with the Bureau's returns for 1902, there has been an increase in the products of the fisheries of the Gulf States of 17,226,613 pounds, or 15.15 per cent., in the quantity and of $3,016,114 or 86,31 per cent., in the value. Compared with the returns for 1908, the increase amounts to 12,649,583 pounds, or 10.69 per cent., in quantity and $1,650,310, or 33.95 per cent., in value.

ROAD-BUILDING PROJECTS WITH FEDERAL AID

THE rate at which the number of Federal-aid road-building projects has increased since the war is shown in a summary relating to all such work from September 30, 1916, to April 30, 1920, which has been prepared by the Bureau of Public Roads, United States Department of Agriculture. On the latter date the states had filed with the bureau 2,885 project statements, of which 2,790 had been approved, representing 27,796 miles of highway. The totals on April 30, 1919, were little more than one third these amounts. Up to May 1 of this year 1,974 projects had proceeded to the stage at which plans, specifications, and estimates had been delivered to the Bureau of Public Roards. The plans, specifications and estimates of 1,827 of these had been recommended for approval, representing 13,845 miles.

Project agreements had actually been executed and construction work was in progress on 1,569 projects, totaling 11,987 miles. In addition, work had been begun on about 100 projects for which agreements had not actually been signed, thus expediting the progress of the work and bringing the total mileage under construction up to 13,540. The summary shows that a great reduction has been made in the time required for preliminary work before the actual construction is begun.

On the average the states have submitted

project statements for nearly 95 per cent. of their respective allotments and have entered into agreement to construct highways which call for about one half of the Federal-aid money. The projects actually completed and paid for are comparatively few, but they are materially exceeded in number by those which are practically completed. California, Delaware, Illinois, Idaho, Indiana, Iowa, Kansas, Louisiana, Maine, Maryland, Minnesota, Nebraska, New Hampshire, New Jersey, North Carolina, Ohio, Oregon, Pennsylvania, Rhode Island, Utah, Washington, West Virginia, and Wyoming have each submitted approved project statements for all or nearly all of their allotments.

THE BREWSTER COLLECTION OF BIRDS

Announcement is made by the American Museum of Natural History of a gift by Frederick F. Brewster, of New Haven, Connecticut, of 3,200 specimens of land-birds collected in the West Indies and South America by Rollo H. Beck, under the direction of Dr. Leonard C. Sanford. A very large part of this material, according to Dr. Frank M. Chapman, curator of the department of birds, is new to the museum's collections, and much of it is contained in no other museum in the world. The collection includes 1,500 birds from the West Indies—chiefly the high mountains of Santo Domingo, from which little-known area there is included a series of the recently discovered crossbill and Patagonia sparrow, known heretofore only from a few specimens in the National Museum in Washington; a large series of two distinct new species, known only in the Brewster collection; and the unique type of a new genus of Goatsuckers. There are also 500 birds from Bahia—of great value, since this is a type locality for many species described by the older writers; and somewhat over a thousand specimens from the extreme southern part of South America, including a representative series from Tierra del Fuego and the Falkland Islands, from which localities the Museum was wholly without material.

HAWAIIAN SCIENTIFIC INSTITUTIONS

Through the generosity of the C. M. Cooke estate the University of Hawaai is to have a marine biological laboratory located in connection with Honolulu Aquarium at Waikiki. The last legislature placed the aquarium in the custody of the university. The laboratory is now in process of construction and will be ready for use by mid-summer. Facilities will be provided for work by visiting scientific men as well as by the students and faculty of the university. Biologists planning to visit Hawaii and wishing to use the laboratory are advised to communicate with Professor C. H. Edmondson, the director of the laboratory, as far in advance as possible. A teaching fellowship carrying a stipend of $750 is open for the next college year and applications will be received from graduate students with sufficient training in zoology and botany.

The trustees of the Bishop Museum in Honolulu and the regents of the University of Hawaii have agreed on the fundamentals of cooperation between the two institutions in scientific investigation and the training of investigators. The general principle of reciprocity in the use of libraries, collections, apparatus and other facilities is laid down and it is also agreed that graduate students in the university may, under proper limitations, have the use of the museum and may carry on part or all of their research under the direction of members of the museum staff. Work done in this manner will be counted toward advanced degrees by the university. The plans contemplate bringing together all systematic collections not required for teaching purposes at the museum.

SCIENTIFIC NOTES AND NEWS

Cambridge University has conferred the honorary degree of doctor of laws upon Dr. Simon Flexner, director of the laboratories of the Rockefeller Institute for Medical Research.

At the centennial commencement exercises of Colby College the degree of doctor of laws was conferred on George Otis Smith, director of the Geological Survey, a graduate of the college in the class of 1893.

COLGATE UNIVERSITY at its recent commencement conferred the honorary degree of doctor of science upon Colonel Alfred Hulse Brooks, of the United States Geological Survey.

BROWN UNIVERSITY has conferred the degree of doctor of laws on Dr. Vernon Kellogg, of Stanford University and the National Research Council.

UPON the occasion of the Golden Jubilee Commencement of Syracuse University, held on June 14, the honorary degree of doctor of science was conferred upon Edward H. Kraus, professor of crystallography and mineralogy and dean of the summer session of the University of Michigan.

AT the seventy-first anniversary commencement of Baylor University, the honorary degree of doctor of laws was conferred on Robert Thomas Hill in recognition of his geologic work in the southwest and the tropical and sub-tropical regions. Dr. Hill will continue his researches upon the geology and geography of the Texas and southern California regions during the summer season.

DR. ELIAS POTTER LYON, dean of the University of Minnesota Medical School, was granted the degree of doctor of laws by the St. Louis University at its recent commencement.

A TABLET in honor of Dr. Charles K. Mills was unveiled at the Philadelphia General Hospital on June 17. Dr. Mills resigned last October after forty-two years' service as chief of the neurologic staff at the hospital. The tablet is of bronze, 48 by 28 inches, with a bas-relief medallion of Dr. Mills' head surmounting it.

ELMER D. BALL, of the Iowa Agricultural College, has been appointed assistant secretary of agriculture. Since his graduation from the Iowa Agricultural College Dr. Ball has been a teacher in agricultural colleges and an investigator of scientific and agricultural problems. He has been dean of the Utah Agricultural College and director of the experiment station, and state entomologist of Wisconsin.

DR. ALBERT C. HERRE, director of the school of hygiene and professor of biology in the Washington State Normal School, Bellingham, Washington, has accepted appointment as chief of the division of fisheries in the Bureau of Science, Philippine Islands.

DR. PEYTON ROUS has been promoted to be a member in pathology and bacteriology of the Rockefeller Institute for Medical Research.

DR. MARSTON TAYLOR BOGERT, professor of chemistry in Columbia University, has been appointed by the president a member of the United States Tariff Commission.

DR. A. C. BOYLE, JR., for ten years professor of mining, metallurgy and economic geology at the Wyoming School of Mines, has been appointed geologist for the Union Pacific Railroad Company.

MR. KENNETH P. MONROE has resigned as chemist in the color laboratory, U. S. Bureau of Chemistry, Washington, D. C., to accept a research position in the Jackson Laboratory of E. I. du Pont de Nemours & Company, Wilmington, Del.

DR. A. G. HUNTSMAN, of the Biological Board of Canada, has visited Washington for a conference with the Bureau of Fisheries in regard to trade names of fishes and other aquatic products for use in the United States and Canada. Dr. Huntsman conferred also as to fishery and oceanographic investigations that may be pursued by the United States and Canada on both coasts under a cooperative arrangement.

PROFESSOR W. B. HERMS, of the University of California, has established a temporary summer laboratory in the Sacramento Valley near Vina, Tehama county, California, for the purpose of investigating certain malaria-mosquito problems in that vicinity, notably factors governing breeding habits of anophelines, their egg-laying habits and per cent. of infection. Three species of Anophelines are present; namely, *A. occidentalis* (western variety of *A. quadrimaculatus*), *A. punctipennis* and *A. pseudopunctipennis* together with a prevalence of malaria. Collaborating with Professor

Herms is Professor S. B. Freeborn, also of the University of California and a small group of students. The present intensive investigation follows a general malara-mosquito survey of California which was completed last summer.

Professor Warren D. Smith, of the University of Oregon, has been given leave of absence to spend a year in geological work for the Philippine government, as chief of the Division of Mines of the Bureau of Science at Manila.

Professor Frank T. McFarland, department of botany, University of Kentucky, has been granted a leave of absence for the year 1920–21. He will spend this summer and next year in study at the University of Wisconsin. While on leave, Professor McFarland's place will be filled by Mr. E. D. Hull, a graduate of the University of Chicago.

By action of the convention of the Sigma Xi Society at its meeting in St. Louis, a limited charter was granted to the University of North Dakota. The installation exercises of this chapter were recently held, Dean Lauder W. Jones, of the University of Minnesota, presiding. These exercises consisted in the formal installation of the chapter on the evening of June 2, followed by the initiation of four active members elected from the faculty, and five associate members from the graduates and the senior class. The exercises were followed by a banquet. On the morning of June 3, Dean Jones addressed the university convocation on the subject of "Science and industry." A fuller account of the proceedings will appear later in the Sigma Xi *Quarterly*.

Dr. Ira Remsen, formerly president of Johns Hopkins University, delivered the commencement address at West Virginia University on June 15. His subject was "This is the Age of Science." After the commencement exercises Dr. Remsen was entertained by the members of the West Virginia Alumni Association of Johns Hopkins, six of whom are heads of departments in the state university.

UNIVERSITY AND EDUCATIONAL NEWS

Cornell University has received an anonymous gift from a professor and his wife of a trust fund for an institute of pure and applied mathematics. The gift amounts to $50,000 and is to be held in trust for a hundred years and allowed to accumulate.

Wallace W. Atwood, professor of physiography at Harvard University, has been appointed President of Clark University, succeeding President G. Stanley Hall, of the university, and President Edmund C. Sanford, of the college. Dr. Hall, who has been president of the University and professor of psychology for thirty-two years reached his seventy-fourth birthday on February 1.

Hector James Hughes, professor of civil engineering and director of the Harvard Engineering Camp, has been chosen dean of the Harvard Engineering School to take the place left vacant by the retirement of Dean Comfort Avery Adams.

W. H. Chandler, professor in pomology at the New York State College of Agriculture, has been appointed vice-director of research at the Cornell University Agricultural Experiment Station. Professor Chandler has been at the college as professor in research in pomology since 1913.

Dr. Norman McDowell Grier has been appointed professor of biology at Washington and Jefferson College to succeed Dr. Edwin Linton, who has retired under the provisions of the Carnegie Foundation.

Dr. Arthur W. Haupt, formerly professor of biology at Carthage College, Carthage, Ill., has been elected to the chair of biology at Saint Lawrence University, Canton, N. Y.

The following changes have been made in the department of medical zoology of the school of hygiene and public health of the Johns Hopkins University. New appointments: Dr. Chas. E. Simon, lecturer in medical zoology; Mr. D. L. Augustine, assistant in helminthology; Dr. W. H. Taliaferro, from instructor to associate in protozoology; Dr. F. M. Root,

from teaching fellow to associate in medical entomology.

DR. LOUIS J. GILLESPIE, professor of physical chemistry at Syracuse University, who was formerly with the Department of Agriculture, Washington, D. C., has resigned to go to the Massachusetts Institute of Technology as assistant professor of physico-chemical research.

DR. ARTHUR F. BUDDINGTON, Ph.D. (Princeton, '16), and Dr. Benjamin F. Howell, Ph.D. (Princeton, '20), have been appointed assistant professors of geology at Princeton University.

DISCUSSION AND CORRESPONDENCE

MODERN INTERPRETATION OF DIFFERENTIALS

IN an advance copy of a note to SCIENCE, which Professor Huntington has kindly sent to me, he says that "*some indication as to the manner in which N is to vary*" is necessary to define $dy = \lim N\Delta y$. This is not true. Of course, there must be some relation between N and Δy, in order that, for example, $\lim N\Delta y = 5$, but the number of such relations is infinite, and it is only necessary to know that they exist. For example, if $\Delta y = (5/N) + (8/N^2)$, then $N\Delta y = 5 + (8/N)$, and for $\lim N = \infty$, $\lim \Delta y = 0$, $\lim N\Delta y = 5$. It was stated in my note which Professor Huntington is criticizing[1] that N varies from zero to infinity. We are not concerned with the method of approach, but only with the possible value of the limit. The preceding illustration shows that if y be an independent variable, such limit dy exists, and in any value we please to name. It is different if y be dependent, and my note in SCIENCE of May 7, contained a demonstration that $df(x)$ exists when the graph of $f(x)$ has a tangent, and determines its construction, corresponding to any value of dx, including in particular, $dx = \Delta x$, which is, of course, not always true.

The problem of differentiation is larger than that of a single value, since it determines an infinite number of corresponding values. We have the analogy of the infinite number of corresponding values of the derivative variable and its argument x. We justify this variable as a limit on the ground that it is a true limit for each numerical value of x. The example having been set, its extension to differentials can not be denied.

The infinite number of corresponding differentials (dx, dy, dz) pertain to the one set of corresponding variables (x, y, z), just as the increments (Δx, Δy, Δz) pertain to it, and are *corresponding increments of the instantaneous state of the variables*, also, *increments in the first ratio* (Newton's "prime" ratio), etc. This is not a vague idea but one which, in numerical cases, determines numerical values. The source of this terminology is the physical idea that *equimultiples of very small simultaneous increments* are *approximately* increments of the instantaneous state. The differential analysis of Newton, which carries this idea to its logical conclusion, is therefore the mathematical foundation for such physical idea.

It is easy to make statements appear vague by separating them from the facts on which they are based, and such facts appear in the article from which Professor Huntington quotes, with a figure showing the *finite equimultiples* which are becoming exact differentials—differentials which his "modern" method can not represent, since they pertain to a system of two independent variables, and of which the derivative calculus can give no adequate idea. although they are of great practical importance.

Such so-called modern method is crude in its limitation $dx = \Delta x$, narrow in its application *only to plane curves in rectangular coordinates*. A natural extension to space is impossible, but Newtonian differentials are coordinates of tangent planes, from their points of contact as origin. By Newton's method, all kinds of continuously variable quantity, in plane or space, lines, areas, volumes, forces, may have corresponding differentials represented in finite quantities of the same kind, and by the limits of finite and visible values.

ARTHUR S. HATHAWAY
ROSE POLYTECHNIC INSTITUTE

[1] SCIENCE, February 13.

NOTE ON DISTRIBUTION AND SPERMATOGENESIS OF MYRIAPODA

DURING the spring of 1912, while working on the Myriapoda of Kansas at the University of Kansas, the writer had occasion to examine a bottle containing several specimens of *Scolopendra,* each of which had been dissected and had had the gonads removed. As there was no label with them, the matter was called to the attention of Dr. C. E. McClung, who stated they were some of the specimens used by Dr. Maulsby W. Blackman in his work on the spermatogenesis of the Myriapoda, which he started at the above-named institution and later continued at Harvard University. As a result of his observations, the writer is convinced a mistake was made by Blackman in the identification of the form used.

Blackman's first paper[1] on the subject states that the specimens used were collected in June, 1900, in Russell county, Kansas, by Mr. W. S. Sutton and are "the large reddish-brown *Scolopendra,* found abundantly in the southwest. It is a large centipede, about four inches long and four lines across." In his second paper,[2] he identifies the specimens he was working on as *S. heros,* but in regard to the location where his material was collected, simply states that this paper is in the nature of a by-product of "a detailed study of the spermatocyte changes in *Scolopendra heros,* now practically ready for publication." This second paper was published from the University of Kansas, so evidently he used the same material that he did in his first and third papers on the subject. In his third paper[3] of the series, he identifies his specimens as *S. heros,* and says that most of the work was done on forms collected in Russell county, Kansas, but "later a number of specimens of the same variety of *S. heros* were received from Beulah, Colorado, through Mr. R. E. Scammon." The last paper[4] in the series referring to this particular species of centipede was based on the same material "which served as a basis of several previous papers (Blackman :01, :03, :05), the majority of the slides having been mounted nine years."

The specimens seen by the present writer, and which formed part of Blackman's material, were *Scolopendra polymorpha* and not *S. heros,* as he designated them. A mistake in the identification of these two forms could easily occur, as each species is very variable not only in color but also in anatomical details, and they have been considered as synonymous by some writers, for example Bollman,[5] whose writings were undoubtedly followed in making the original identification. However, they have been considered as distinct species for some time,[6] the main difference between the two being that *S. heros* has two fine longitudinal lines or furrows on the cephalic plate which diverge cephalad, while *S. polymorpha* is without these lines.

The geographical distribution of the two forms also confirms the fact that Blackman was mistaken, as there is no record of *S. heros* having ever been taken north of the southern tier of counties in Kansas, while *S. polymorpha* is known to occur throughout the state.[7] Russell county, where Blackman's

[1] Blackman, M. W., "Spermatogenesis of the Myriapods. I. Notes on the Spermatocytes and Spermatids of *Scolopendra,*" *Kans. Univ. Quart.,* 10: 61–76, pls. 5–7, 1901.

[2] Blackman, W. M., "Spermatogenesis of the Myriapods. II. On the Chromatin in the Spermatocytes of *Scolopendra heros,*" *Biol. Bull.,* 5: 187–217, 22 figs., 1903.

[3] Blackman, W. M., "Spermatogenesis of the Myriopods. III. The Spermatogenesis of *Scolopendra heros,*" *Bull. Mus. Comp. Zool. Harvard,* 48: 1–138, pls. 1–9, 1905.

[4] Blackman, M. W., "Spermatogenesis of the Myriapods. VI. An Analysis of the Chromosome Group of *Scolopendra heros,*" *Biol. Bull.,* 19: 138–159, pls. 1–2, 1910.

[5] Bollman, Charles Harvey, "The Myriapoda of North America," *Bull. U. S. Natl. Mus.,* No. 46, 1893. (See pg. 175.)

[6] Kraepelin, Karl, "Revision der Scolopendriden," *Jahrb. Hamb. Wiss. Anst.,* 20: 1–276, 1903.

[7] Gunthorp, Horace, "Annotated List of the Diplopoda and Chilopoda, with a Key to the Myriapoda of Kansas," *Kans. Univ. Sci. Bull.,* 7: 161–182, pl. 20, 1913.

specimens came from, is some one hundred and twenty-five miles from the southern boundary, in the center of the state. Regarding the specimens from Beulah, Colorado, which Blackman recognized as "the same variety of *S. heros*" as those collected in Kansas, the altitude of this place (over 5,000 feet) would strongly preclude the possibility of *S. heros*, a sub-tropical form, being found there. Also, the fact that Blackman does not record any difference in the germ cells of these Colorado specimens from those collected in Kansas would prove that they were one and the same species.

HORACE GUNTHORP

WASHBURN COLLEGE,
TOPEKA, KANS.

QUOTATIONS

THE ENDOWMENT OF BIOCHEMICAL RESEARCH IN ENGLAND

OUR university correspondent at Cambridge sends us the announcement of a munificent benefaction about to be made for research in biochemistry. A minimum aggregate expenditure of £165,000 is contemplated, and this sum, if necessary, will be supplemented. The scheme includes the erection of buildings on a site to be provided by the university, equipment, provision for maintenance, £25,000 for the endowment of a professorship, and £10,000 for a readership. The money comes from the residuary estate of the late Sir William Dunn, banker and merchant, and Liberal member for Paisley. The testator died in 1912, leaving a fortune valued at a million pounds, and appointing the directors of the Commercial Union Assurance Company as trustees, with some discretionary powers as to the disposal of his residual estate. There were pencil alterations in the text of the will, and it was only after a lawsuit that the trustees were able to act. They appointed an advisory committee under the chairmanship of Sir Jeremiah Colman, and many schemes were considered. Numerous and substantial gifts have been made to well-known philanthropic institutions, but the trustees reserved a large sum to provide a lasting and fitting memorial of Sir William Dunn's generosity and to carry out his expressed wishes for the alleviation of human suffering and the encouragement of education. The benefaction to Cambridge should serve both these objects. Certainly it represents one of the most munificent and complete gifts ever made to one of the older universities. Only last month we congratulated the University of Oxford on Mr. Edward Whitley's offer of £10,000 towards the endowment of a chair of biochemistry, and on a donation of £5,000 from the British Dyestuffs Corporation to the laboratory of organic chemistry. We may hope that the friends of Oxford and of scientific research will do something to equalize the good fortune that has come to Cambridge. The chemical activities of the living cell and the living tissues provide a limitless field of research. Knowledge of them is only beginning, and until the methods and results of biochemistry have been developed, the practise of medicine will remain empirical, and fashions in drugs will change as quickly as fashions in ladies' hats. The old universities have the tradition of research, and their spirit of detachment supplies an atmosphere suitable to inquiries not too closely bound to immediately utilitarian objects. We rejoice in the great opportunity given to Cambridge, and do not doubt but that she will prove worthy of it—*The London Times*.

SCIENTIFIC BOOKS

Die Stämme der Wirbelthiere. By OTHENIO ABEL. Publ. 1919 by Verein wiss. Verlegn., W. de Gruyter and Co., Berlin and Leipzig. 914 pages, 669 text figures.

It is to be regretted that there is no good comprehensive modern text-book in English dealing with vertebrate paleontology. The researches of the last twenty years have perhaps made less change in fundamental viewpoints and theories in this than in some other branches of science. But they have added enormously to the data of facts upon which it rests, and knit closer its relationships with the cognate sciences, geology on one side, zoology and comparative anatomy on the other.

Dr. Abel is professor of paleobiology at the University of Vienna, a pupil of the great Belgian scientist Louis Dollo, and a leading authority in his profession. He is the author of two earlier text-books, "Paleobiologie" and "Die vorzeitlichen Säugethiere," the first of which was reviewed in SCIENCE some years ago.

The present volume treats of the origin and evolution of the various phyla ("Stämme") of vertebrates as shown in the paleontologic record. It is concerned almost wholly with extinct forms; and thanks to this limitation the author has been able to give an unusually full treatment and discussion, especially of the reptiles and Amphibia. The illustrations, while somewhat crude artistically, are excellent for teaching purposes, and its full discussion and fair treatment of recent foreign discoveries are remarkable in a volume prepared and published under war conditions. From first to last Dr. Abel has endeavored to discuss the evidence and give reasons for the conclusions adopted, leaving the way open for difference of opinion on many doubtful problems. A certain unevenness of treatment is manifest, both in the discussion and the taxonomic arrangement, and many details of presentation and classification are open to criticism, as is inevitable in a volume of such wide scope and fundamental treatment. From errors of fact the book is singularly free.

A classified list of the orders and families accepted, with characteristic genera, serves as a preliminary conspectus. To the fishes are allotted 160 pages, partly introductory and dealing chiefly with the early and primitive types. The vast variety of modern bony fishes are treated in a very cursory manner. The Amphibia cover 110 pages, devoted mostly to the Paleozoic types and their relations to the higher vertebrates. The extinct reptiles are quite fully treated, the discussion covering some 355 pages. The most serious criticisms to be made in this section are of the splitting of the pterodactyls into two distinct orders, and the attempt to limit the term dinosaurs to one of the two great orders of gigantic land reptiles that are now understood to be included in the old usage of the name. It would be better to retain it with the old scope but in a general unsystematic sense, like "pachyderms" among the mammals. On the other hand, the discussion of important researches and discoveries among fossil reptiles and their bearing on the evolution of the vertebrates affords an excellent synthesis of recent progress in the science. Birds are a rather minor group among fossil vertebrates, and 23 pages suffice to cover all the important types in their evolution.

The treatment of the Mammalia is relatively brief, covering 167 pages, passing very briefly and uncritically over some of the orders, and hardly touching upon the Primates, but more extended with other groups, and especially authoritative in the Cetacea, upon which the author has published several very valuable researches.

While by no means endorsing all of the author's views upon problems of evolution and classification, the present reviewer does not hesitate to commend Dr. Abel's work as highly authoritative and up to date, admirably presented as to form and reliable as to fact. The treatment of the subject differs widely from that in the new edition of Zittel's "Grundzüge der Paläontologie," recently revised by Schlosser and Broili, which affords in many ways an excellent supplement for Abel's volume, especially in its more comprehensive treatment of the Mammalia.

W. D. MATTHEW
AMERICAN MUSEUM OF NATURAL HISTORY

SPECIAL ARTICLES

AN ULTRAMICROSCOPIC STUDY OF THE TWO STAGES OF BLOOD COAGULATION[1]

SCHMIDT[2] has described carefully the process of coagulation as it may be followed with the naked eye in the cell-free plasma of a slowly-clotting mammalian blood (horse). He drew attention to the fact that the process may be

[1] From the Physiological Laboratory of the Johns Hopkins University.

[2] Schmidt, "Zur Blutlehre," Leipsig, 1893, p. 262.

separated into two distinct stages from the standpoint of the changing physical properties and macroscopical appearance of the plasma during the progression of clot-formation. First, the fluid plasma is seen to be transformed into a definite but transparent coagulum of which, "on pressure between the fingers, almost nothing remains." This delicate coagulum marks the first visible or palpable stage in the development of the clot. On standing, the transparent, almost structureless, yellow coagulum is observed to become gradually more and more turbid; until at length the second stage is reached, in which the coagulum appears quite opaque and whitish, and assumes the typical characteristics of a firm, fibrin clot. By the use of paraffined vessels and low temperature, the coagulation of human or cat's blood may be delayed sufficiently to permit centrifugalization in order to obtain a clear, cell-free plasma for observation; or one may study the coagulation which follows the recalcification of a centrifugalized oxalted plasma. In either of such quickly-clotting plasmas it is, of course, more difficult, but nevertheless quite possible, to divide the progress of coagulation into the two stages described above.

The transparent-stage and the opaque-stage of blood-coagulation are certainly striking physical phenomena. The question accordingly presents itself: Has each of these stages a separate, underlying causal reaction, or do they represent gradations in a continuous transformation of a sol into a gel? Are the two separate stages superimposable upon separate reactions occurring between the coagulation factors, or does the transparency or opacity of the plasma, as well as its consistency, merely reflect the extent of fibrin-formation?

It seemed that this question might find immediate solution if it could be determined at what point fibrin first makes its appearance during the coagulation of a tube of plasma. In comparison with the appearance of the fibrin which we recognize in a firm, opaque clot, certainly the transparent-stage appears to be entirely fibrin-free. Now it is well known that during coagulation, the formation of fibrin needles can be followed from the beginning with the aid of the ultramicroscope. Howell[3] has described and figured this beautiful phenomena, in which "bright specks appear first as short rods, which exhibit a genuine saltatory movement, jumping abruptly into and out of focus, and quickly fusing to form longer rods and needles" of fibrin. It was at the suggestion of Dr. Howell that it was decided to use the ultramicroscope as a method of approach to the solution of the question outlined above. The Siedentopf and Zsigmondy slit ultramicroscope, with water-immersion objective was the instrument used; illumination was obtained from a carbon arc-light.

After trying various methods, the following procedure was found to yield the most satisfactory results: a horse was bled from the external jugular vein through a paraffined needle into a paraffined tube packed in ice. The blood was taken to the laboratory, filtered through a paraffined funnel surrounded by an ice-jacket, and the cell-free plasma caught in a second iced, paraffined tube. Plasma was then, by means of a chilled paraffined pipette, introduced in rapid succession into (1) the cell of the ultramicroscope; (2) a control cell of the same size and shape, not attached to the ultramicroscope, and (3) a homeopathic vial (into which ½ c.c. of plasma was placed in each experiment). These three containers could be filled within ten seconds, so that coagulation began in all three practically at the same moment. To eliminate any error of interpretation which might conceivably arise from the fact that one vessel was filled a few seconds before another, the order in which they were filled was varied in different experiments. There was, however, no evidence indicating that this theoretical source of error had the slightest influence upon the results in any experiment.

The rationale of using three plasma containers in these experiments may be here explained: (1) The cell of the ultramicroscope was observed closely after filling, in order to determine the time of appearance of the earliest visible needles of fibrin; (2) the homeopathic

[3] Howell, *Am. Jour. Phys.*, 1914, XXXV., 143.

vial served to hold a gross specimen of coagulating plasma in which the time of appearance of the transparent and opaque stages could be compared with that of the appearance of fibrin needles in the ultramicroscope cell. However, as it was found difficult to determine the earliest moment at which the viscous plasma could be considered to have entered the gel-stage, a more delicate criterion of the onset of this transparent stage was devised by using (3) the control cell. This cell, being of the same size and shape as the ultramicroscope cell and being filled at the same time, could be assumed to favor a progress of coagulation synchronous with that occurring within the cell of the ultramicroscope. The tubal prolongation of the control cell was immersed at frequent intervals beneath the surface of a normal saline solution, and a very small amount of plasma allowed to escape into this fluid. If the plasma at once diffused through the salt solution it is clear that it was still in a state of fluidity; if, however, it emerged from the tube in the form of a delicate, transparent "worm" which floated in the solution, preserving the contour of the tube, the plasma was considered to have entered the transparent gel-stage. This proved to be a very delicate test; transparent "worms" could be obtained at such an early stage that agitation of the liquid in which they were suspended would cause them to vanish into the solution—a degree of gel-formation too slight to be discerned by the observation of plasma contained within the homeopathic vial.

In each experiment, the time at which the containers were filled was recorded; likewise a note was made of the time at which fibrin-needles were first to be seen with the ultramicroscope, at which a transparent worm-like gel could first be obtained from the control cell, and at which an opaque clot appeared in the homeopathic vial. The point of interest lies, of course, in the time relation between the occurrence of the transparent gel-stage (as evidenced by the control tube) and the first appearance of fibrin needles under the ultramicroscope. A typical experiment will serve to exhibit this relation:

BLOOD OBTAINED FROM VEIN (HORSE) AT 2:25 P.M.; FILTERED AT 3:30 P.M.

Time	Ultramicroscope Cell	Control Cell	Homeopathic Vial
3:37...	Plasma introduced	Plasma introduced	½ c.c. plasma introduced
3:39...	No fibrin needles	Plasma liquid	Plasma liquid
3:41:30	Scanty fibrin needles	Plasma forms "worm"	No definite change
3:44...	Fibrin needles more numerous	Plasma forms firmer "worm"	Transparent gel present
3:50...	Fibrin needles very dense	....	Opaque clot
4:04...	Refilled with plasma	Refilled with plasma	½ c.c. plasma introduced
4:06...	No fibrin needles	Plasma liquid	Plasma liquid
4:08...	No fibrin needles	Plasma liquid	Plasma liquid
4:09...	No fibrin needles	Plasma liquid	Plasma liquid
4:11...	Fibrin needles present	Plasma forms "worm"	Plasma liquid
4:12:30	Fibrin needles more dense	....	Transparent gel present
4:16:30	Fibrin needles very dense	....	Opaque clot

Such experiments demonstrate clearly that all of the reactions leading to the formation of fibrin have occurred before the transparent gel-stage appears; for fibrin needles are demonstrable in the coagulating plasma in the earliest stages of gel-formation. Indeed, in a number of experiments, a few scattered needles of fibrin were seen with the ultramicroscope before any gel-formation could be demonstrated in the plasma. Microscopically then, the only difference between the so-called transparent-stage and opaque stage of coagulation lies in the greater number of fibrin needles present in the latter. Their gradual development can be watched with the ultramicroscope, and many such experiments (in which the oxalated and unoxalated plasma of man, horse, cat and dog, were tested) prove clearly that the macroscopically observed transition of a liquid plasma through a transparent gel-stage into an opaque fibrin clot, represents merely a continuous progression of fibrin-formation.

SUMMARY

There is no reaction-basis for the division of the process of blood-coagulation into the

two stages (transparent and opaque) which appear so strikingly in slowly-clotting mammalian blood. These stages are superficial phenomena which merely reflect the extent of fibrin-formation. Coagulation is a gradual continuous process of fibrin-formation; and in the clotting of normal plasma, fibrin needles can be demonstrated in the earliest appreciable coagulum, however delicate, transparent or gel-like.

ARNOLD RICE RICH

THE KENTUCKY ACADEMY OF SCIENCE

THE seventh annual meeting of the Kentucky Academy of Science was held at the University of Kentucky, Lexington, on Saturday, May 8, President P. P. Boyd presiding. The secretary's report showed a membership of 110, and 24 new members were elected at this meeting. Resolutions were adopted accepting the terms of affiliation with the American Association for the Advancement of Science and establishing two classes of active members: national and local; and looking to cooperation with the American Ecological Society in preservation of natural conditions. The principal address, "The twentieth century's contribution to our knowledge of the atom" was delivered in the afternoon by Professor R. A. Millikan, who was afterwards elected an honorary member of the academy.

The following program of papers was rendered:

President's address. *The future of the Kentucky Academy:* DEAN PAUL P. BOYD, University of Kentucky. The speaker presented first the summaries of state academies given by Mr. D. D. Whitney in SCIENCE of December 5, 1919 and then told the results of a questionnaire which he had lately sent to secretaries of state academies, the object being to ascertain the future and the field of such organizations. He concluded that there is a definite need for them and urged that the Kentucky Academy begin a forward movement in order to fill more properly its field in the nation-wide organization of science. Some of his suggestions were that the academy cooperate more effectively with the national bodies; that membership be extended more widely to educational and industrial plants; that science clubs be organized throughout the state; that better science teaching in the high schools be promoted; that funds be solicited from the legislature and private sources for publication and research funds; that committees be formed for the study of important state problems and for state surveys; and that recommendations be formulated for presentation to the next legislature.

Blood lines of genetic value: W. S. ANDERSON, Kentucky Experiment Station. In the domestic breeds of live stock great sires seldom produce more than one or two sons that are greater progenitors than themselves. This means, in blooded stock, that the greatness of any given blood line is handed on by one or two in any one generation, the others of the generation merely add members. In support of the statement, the great sires of nine breeds of domestic animals were cited and the few sons of each were named who have been instrumental in handing on the breeds.

Failure of lettuce to head: A. J. OLNEY, and W. D. VALLEAU, Kentucky Experiment Station. The various physiological troubles associated with the failure of greenhouse head lettuce, including those known as rosette, tip-burn, black heart and elongation of the central stalk with the production of laterals (Rio Grande disease), have been found to be associated with a root rot apparently due to *Fusarium*, sp. Soil sterilization by steam and formaldehyde have only partially controlled the trouble, due probably to incomplete sterilization of the lower soil layers.

Variation in Abutilon Theophrasti Medici: CHARLES A. SHULL, University of Kentucky. This paper is a report of progress in an investigation of variability in the number of carpels in the ovaries of *A. Theophrasti.* The range of variability is from ten to seventeen, with the mode usually on fourteen or fifteen. The material shows a skewed frequency distribution, and tendency toward half Galton-curves. A number of plants have been found with half curves and the mode on 15. But whenever a number of plants are counted together, there are usually a small number falling on sixteen. Only three specimens in about 8,000 had seventeen carpels to the ovary. The mode falls on a lower number in material collected in Kansas than in similar material from Kentucky. The drier climate of Kansas is probably responsible for this difference. If plants from an unfavorable habitat are counted the mode is found to be depressed. The modifications of the variability curves noted are probably related rather directly to nutritional conditions. Heredity and suboptimal nutrition are believed to be responsible for the half-curve variability.

Some factors to be considered in attempting to communicate with supposed inhabitants of Mars:

Henry Meier, Centre College. In the first place, the probable low temperature, rarified atmosphere and absence of water are against the existence on the planet of beings endowed similarly to us. Ability to signal by light is negatived by the fact that the earth's atmosphere would absorb about 40 per cent. of the light sent out, and by the great distance. The author estimates that an area of light 10 miles square, on the earth, if seen from Mars through a telescope magnifying 500 times, would appear like an area 1 inch square, viewed at a distance of 500 feet. The possibility of signaling by radio is negatived by the distance, it being computed that it would require a current of a million amperes at the sending station in order to obtain one of one ampere at a receiving station on Mars, when the planet is nearest the earth. Besides, the powerful currents radiated from the sun would probably overwhelm the weak waves from the earth.

The future of nutrition and medicine: Dr. A. W. Hombergeb, University of Louisville. The paper brought out the close relation between diets in health and disease. It laid emphasis upon the benefits derived from urine and blood analyses. Urine analysis is not new and yet, with the modern methods of blood analysis, it becomes a new and valuable aid in treating diseases. The direct relations were illustrated by the conditions found in the body under diabetic conditions. Tables showing analyses representing the work of some 80 men on blood and urine were presented—also a classified schedule of dietaries the object of each group being to throw together foods particularly adapted to the diseases involved. The author predicts that in the future there will be a closer scientific relation between the nutrition of the sick and medicine than there has been in the past.

Asphalt coal: W. R. Jillson, state geologist. By title.

Note on the occurrence of cretaceous sediment in the "between the rivers" section in Trigg and Lyon counties: W. R. Jillson, state geologist. By title.

Some observations on the life-history of the praying mantis: Miss Mary Didlake, Kentucky Experiment Station. Two species, the common *Stagmomantis carolina* and a big Chinese one, *Tenodera sinensis,* were carried through several generations in as many successive years, reared in the laboratory, individuals being kept separate, at first in homeopathic vials, then in 4-ounce, wide-mouthed bottles and finally in 6-inch stender dishes. Hatching, molting, regeneration of limbs and antennæ, mating, egg-laying, all were frequently observed and recorded. It was found possible to distinguish the sexes after the first molt and with certainty after the second. The native species required about 80 days to become adult, males commonly molting only 6 times and females usually 7 times. The Chinese species averaged 78 days to adult emergence and both sexes molted 7 times, a few individuals requiring 8 molts.

Materia prima: Rev. E. L. van Becelaere, Cardome. The medieval conception of the "Materia Prima" may appear thoroughly superseded by the discoveries of modern chemistry; however, such a conception, if properly understood, finds a confirmation in them rather than a disproof. The possession of a similar order of fundamental properties by each one of the elements recognized by modern chemistry, in spite of the differentiations peculiar to each of them, reveals one substratum common to all, although diversified in each one. That substratum is the "Materia Prima" accessible only to the mind, yet real and existing in each of the elements.

Some interesting fungi of the Kentucky Mountains. The lichens of Cowbell Hollow: G. D. Smith, Eastern Kentucky State Normal School. Nearly 100 excellent lantern slides in natural colors, prepared by the author, were exhibited and explained, illustrating fungi and lichens observed.

The value of memory systems: J. J. Tigert, University of Kentucky. An experiment is described with a class of 45 students in psychology. The test consisted in having the class memorize an extract from Keats, before studying the memory system, reproducing the words and ideas after three minutes and repeating the same process with a similar extract after studying the system. The result was negative.

A little-known subterranean crayfish: H. Garman, Kentucky Experiment Station. The underground streams of Kentucky are inhabited by an interesting crayfish with small eyes that lives and breeds at all times in these subterranean waters, only appearing in any numbers at the surface during freshets and retreating again from the light when it has an opportunity. It appears to be the eyed crayfish of early explorers of Kentucky caves, who assumed that it was merely a stray from among ordinary eyed crayfish of surface waters and regarded as identical with the widely distributed *Cambarus bartoni.* Somewhat recently it has been described as a variety of this surface-water

species by W. P. Hay, who named it *C. bartoni*, var. *tenebrosus*. It is a good species, however, of different general conformation from the species named, with which it does not intergrade. In fact, the surface-water species does not occur in some localities in which this small-eyed species is found. As a valid species it is believed to be entitled to the name *Cambarus tenebrosus*.

A new phyllopod crustacean from Kentucky: H. GARMAN, Kentucky Experiment Station. Temporary pools in Bluegrass Kentucky sometimes yield in early spring a species of *Eubranchipus* differing from the common species (*E. vernalis*) of eastern states and also from those found in Illinois and other middle states. The name *Eubranchipus neglectus* is assigned to it. During the thirty years it has been known to the author it has diminished in numbers, owing to changing conditions, and seems likely to become extinct; it has, in fact, disappeared in certain pools where thousands could have been secured twenty-five years ago.

Studies in the etiology of infectious abortion in live stock: E. S. GOOD, Kentucky Experiment Station. *Bacillus abortus* Bang is the organism causing the disease in the cow, in the United States, the same as in foreign countries. In 1911, a bacillus was isolated at the Kentucky Station from an aborted foal which we placed in Sub-group 2 of the Colon-typhoid group, which was found to be the cause of the disease in mares and jennets in Kentucky. Since that time, this germ has been found to be the causative agent of the disease in different states of this country, also in Canada, Holland and Sweden. Our results in immunizing mares against the disease are encouraging. Our investigations, so far, show that the *Bacillus abortus* Bang is the causative agent of the disease in sows.

Mineral constituents of the paired seeds of cocklebur: J. S. MCHARGUE, Kentucky Experiment Station. The impression is general that one of the two seeds of a cocklebur (*Xanthium*) will germinate the first spring after maturity and the second will remain dormant until the second spring thereafter. Previous investigators have attributed this apparent dormancy to inherent differences in the embryos and the seed coats. The writer finds that both seeds, if well developed, will germinate at approximately the same time, if they are removed from the burs and planted in moist sand. If allowed to remain in the burs, only one seed germinates until the bur disintegrates and decays, when the second seed will germinate. The mineral constituents contained in the two seeds were found to be practically the same. The large seeds average about 65. mgs. and the small seeds about 45. mgs. The large seeds produce larger seedlings. This is accounted for by the fact that a large seed contains much more plant food than a small one.

Hydrogen ion concentration and biological reactions: D. J. HEALY, Kentucky Experiment Station. The fundamental importance of hydrogen ion concentration in the study of colloids, gels, enzymes and microbes was pointed out and illustrated by exhibits. An organic colloidal liquid at pH7.8 could not be past through a Pasteur-Chamberland F. bougie, but on adjusting the value to pH2, it passed easily. A 10 per cent. bacto-gelatin at pH5 formed a perfect gel, but with acidity equal to N/2 HCl or alkalinity of pH10, there was no gel. The oxidase of raw potato or apple was quite active at pH1.7, as shown by change in color of slices exposed to the air, but when fresh slices were soaked 15 minutes in water adjusted to pH1 and pH1.4, respectively, they dried in the air, without material change of color. A bacillus isolated from the afterbirth from a mare grew readily on agar slants of pH6.8 but failed to grow on similar slants at pH6.4.

A study of inheritance of coat colors in Jersey cattle: J. J. HOOPER, University of Kentucky. Studies of inheritance of Jersey cattle coat colors by the author show that white spots are recessive to dominant solid color, and a white tongue and tail-switch also are recessive. Colors of 1,145 calves were tabulated and compared with those of their 2,290 sires and dams. Some bulls studied seemed to be pure dominants, as their calves were all solid in color, although as many as a hundred were sired by each bull. It was found that 66 per cent. of Jersey cattle are solid in color and have black tongue and switch, while 12 per cent. are broken and have white tongue and switch; 3.6 per cent. are solid and have white tongue and black switch, etc.

Animal versus vegetable proteins in the ration of laying hens: J. HOLMES MARTIN, Kentucky Experiment Station. An experiment, now in its third year is described, in which 4 pens of 25 S. C. White Leghorn pullets, each, are being fed a basic ration of shipstuff and ground oats, supplemented by animal and vegetable protein carriers. The total egg production per pullet for the pen receiving buttermilk was 338 eggs; for that receiving tankage, 268; for that receiving tankage and cotton-seed

meal, 208; and for that receiving cotton-seed meal, 55. On reversing the rations in the cottonseed-tankage and cotton-seed pens, the egg production was reversed, showing that the difference in production depended on the ration. All pens received oyster shell, grit and charcoal.

The seed corn situation in Kentucky: W. D. Valleau, Kentucky Experiment Station. Investigations carried on at the Kentucky Experiment Station indicate that practically all seed corn in the corn belt is infected with *Fusarium moniliforme* Sheldon, and that this organism is capable of causing a root and stalk rot of corn. Infection on an ear appears not to be localized. Slightly infected seed may show no signs of infection, if grown only for a period of seven or eight days. Reddish discolorations developing in the seed coats during germination are an indication of infection. Seed studied was obtained from Kentucky, Georgia, Mississippi, Tennessee, Kansas, Arkansas, Missouri and Minnesota.

Veterinary science: W. W. Dimock, Kentucky Experiment Station. The author stressed the pressing necessity for research upon the nature and causes of diseases in live stock. He showed that the future of animal industry depended upon the control of animal diseases and that control can be secured only after the cause is known. He cited as an example the need for exact knowledge of the life histories of the internal parasites known as nematodes and showed how extensive are their ravages in horses. He believes that here, in their life history and in their effect on the host, is a field holding great promise to the investigator.

Notes on the rapid analysis of magnesian limestone: S. D. Averitt, Kentucky Experiment Station. A differential method for the analysis of relatively pure magnesian limestone, without an actual determination of either Ca or Mg, which is quite rapid and sufficiently accurate for agricultural and most other purposes, is described. Determinations to be made are, A, neutralizing power of the limestone against N/2HCl, expressed as $CaCO_3$; B, weight of insoluble matter + NH_4OH precipitate, from the same portion. Then

$$100 - B = \%\ CaCO_3 + MgCO_3,$$

and

$$5.35\ (A - (100 - B)) = \%\ MgCO_3.$$

Notes on light and light pressure: C. C. Kiplinger, Mt. Union College, Alliance, Ohio. Some evidence is presented indicating that mass is not a universal property of light and certain photochemical absorption experiments are described which show no measurable increase in weight of the reagents, following the action of light.

Experiments with lime, acid phosphate and soil fungicides on land infested with root-rot disease of tobacco: G. C. Routt, Central Experimental Farm, Ottawa, Canada. Experiments are described looking to the possible control of the root-rot disease by applications of lime, acid phosphate, mixtures of lime and sulfur, dilute sulfuric acid, land plaster, copper sulfate, potassium polysulfid, gas lime, ferrous sulfate and formaldehyde. Acid phosphate seemed to be very beneficial in some instances, as did sulfuric acid, but the majority of the experiments gave negative results. The author concludes that the disease can not be controlled in this way.

Plant growth: G. D. Buckner, Kentucky Experiment Station. Comparative study was made of the translocation of the ash, phosphorus, calcium and magnesium from the cotyledons of germinating garden beans, *Phaseolus vulgaris*, when grown in distilled water culture and in garden soil. In the distilled water culture 55 per cent. of the original ash, 57 per cent. of the phosphorus, 25 per cent. of the calcium and 59 per cent. of the magnsium was translocated to the seedling, while, in the seedlings grown in garden soil, 91 per cent. of the ash, 92 per cent. of the phosphorus, 78 per cent. of the calcium and 83 per cent. of the magnesium was utilized by the seedling. The abnormal condition caused by the distilled water culture is shown and that less calcium than any of the other elements studied was removed from the cotyledons by the growing seedling is suggestive of its insoluble form in the cotyledons and its structural function.

Alfred M. Peter,
Secretary

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

Friday, July 16, 1920

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE COLLEGE TEACHER AND RESEARCH[1]

It is a part of the function of every progressive institution of learning, not only to impart knowledge to students, but to do its share in accumulating knowledge for the benefit of mankind. To this end, scientific research in some form is indispensable to the best attainment of a college.

It is far from my thought to place the importance of research on as high a plane as that of training character, but it is hoped that there may appear some elements in common to the two, and no lack of consistency between them.

It can hardly be doubted that there is such a thing as a research instinct. A small boy exhibits it when he picks to pieces a dead fly, or tries to make ink out of mud, or puts a firecracker in a glass bottle to see what will happen. Curiosity is an inseparable ingredient of the human make-up, and research is curiosity directed by a noble purpose and put to a noble service. There is something about the acquiring of first-hand knowledge that stimulates individuality and gives a sense of personal achievement. And with a person whose life and activities are chiefly intellectual, the exercise of this instinct is as essential to his progress as eating is to his physical welfare.

One of the sad privations in the life of a foreign missionary is said to lie in the fact that he is constantly giving out to those about him, without having the spiritual refreshment that would be afforded by association with kindred minds. He is constantly teaching religion to ignorant, undeveloped people, and longs for someone who will understand and sympathize with his point of view. Too often, the teacher of science in the small

[1] Address given before the physics luncheon at the Iowa Academy of Science, April 23, 1920.

college is an isolated missionary among barbarians who know not even his language, and who can give little inspiration to his particular work. And as the foreign missionary must refresh himself first-hand at the source of all spirituality, so ought the college scientist to get his needed inspiration by digging into Nature's secrets and striking for himself the fountains of scientific truth.

Too much can hardly be said by way of caution to college professors against growing "stale." Shut out from the intellectual communion which they crave by their virtual isolation from their own particular species (except at long intervals on such happy occasions as this); oppressed by a monotonous routine of hearing recitations, conducting quizzes, correcting papers and notebooks and attending faculty meetings; and oft-times discouraged by a lack of all evidence of appreciation, at least as expressed by any adequate compensation or equipment: what wonder is it that these men are prone to fall into the commonplace, to vegetate, as it were, and fail even to keep pace with the progress in their own fields? There is only one remedy. It is *action*. And research is action that extends to the very roots of the scientist's being (if, indeed, he be a true scientist at all), and regenerates his whole professional attitude.

There are, furthermore, certain very practical advantages to be gained from a reasonable activity in research. One can not engage in such work without becoming tolerably familiar with the field in which it lies, and with the subjects associated with it. It furnishes an incentive to more thorough study on the part of the teacher himself, and gives a mastery and a self-confidence in teaching, along these particular lines at least, that could hardly be gained otherwise. The professor of physics, for example, who has worked out some little line of inquiry connected with radio-activity, even though it be with the aid of a home-made electroscope housed in a tin can, and utilize no more expensive radio-active preparation than a cast-off Wellsbach mantle, has had first-hand experience with the obstinacy of electroscopes and the practical difficulties of radioactive experiments generally that will give him the feeling of knowing what he is talking about when it comes to teaching that part of his subject. The same circumstance gives the teacher the more complete confidence of his students and colleagues, who justly feel that a man who is making original contributions to his science is one who can be trusted to teach it with some authority. Nor is this feeling confined to the individual: it reflects credit upon the college and gives it character among scholastic institutions in such proportion as its researches are published and become known to the intellectual public.

There is also a still more direct benefit to the college whose professors are engaged in productive research in the laboratories of their own departments. Students like to see things. However reassuring may be the knowledge that their teachers have formerly studied and done research in some university or other, there is nothing so stimulating to their immediate interest as the opportunity to see research actually going on, to see new truth actually coming to light. The botanist who can beckon to his students to the microscope and say that here is a form of life never before described, or the geologist who can take his class to a rock exposure that disproves some prevalent theory of local geology, excites at once the interest and confidence of his pupils. No text-book statement is half so convincing. And the college student takes a measure of pride, and experiences a sort of awe, in the presence of what seems to him to be genius.

Can any one deny that the students in our hundreds of small colleges have as good a right to such advantages as the students of the few large universities of the land?

Now there seems to be an unfortunate impression among scientific people that research is practicable only with the elaborate equipment and in the surcharged atmosphere of the great university graduate school. It must be admitted that there are many research problems of which this is in a measure true. But research, like music, has its rôles, of which the minor ones have their own

peculiar importance and offer their own peculiar opportunities. If every musician aspired to play the pipe organ or to conduct a fifty-piece orchestra, it would indeed be an expensive and ambitious undertaking to become a musician. But some of the finest music is produced on the simplest instruments, or by the unaided voice; and it should be remembered likewise that successful research depends more upon the industry and personality of the man who engages in it than upon the apparatus which he may have at his disposal.

If college men are not recognized as research workers, it is because they do not produce; and if they do not produce, it is because they do not have it in them to do so, or else it is because they do not try.

The institution represented by the writer is not wealthy, but it is illustrative that, out of a dozen or more pieces of research in physics undertaken within as many years, only two have called upon any assistance whatever in the way of equipment from outside sources. Right-minded college authorities (and there are such) are not averse to making some reasonable provision for research work. I have observed that presidents and trustees gauge their appropriations largely by the confidence which they have in the man asking for equipment, in the wisdom and economy of his selections, in the uses to which he is likely to put the material purchased, and in the care which he is likely to take of it; and if they know that he will take every precaution to save the institution unwarranted expense, that fact will go a long way toward liberalizing their policy. Problems can be selected that depend upon diligence, care and skill, rather than upon elaborate apparatus.

A most encouraging circumstance also is the fact that there are great research agencies which have expressed themselves as only too glad to lend a hand in any worth-while problem that the college man may wish to enter upon. This is true of the great universities themselves; it is true of the National Research Council. To test this point, let any competent college scientist who genuinely wishes to do research work, but who lacks certain essential items of equipment, confer with the head of the appropriate department in this or any other graduate university, or make known his needs to the National Research Council at Washington, and discover how readily these institutions will give him, not only their material cooperation, but the best of their wisdom as well, in the problem to which he is addressing himself. The Research Council has even gone so far as to initiate a sort of bureau of exchange of research apparatus for the assistance of workers in just such cases. And the writer finds it difficult to express his appreciation of the ready liberality, and evidence of confidence, with which his own *alma mater* has supplied the somewhat heavy demands that some of his more recent work has made upon her resources.

A common plea among non-productive scientists is that they do not have time. That excuse is threadbare and in tatters. Men have time for what ever is worth while in the exercise of their powers. The amount of work a man can accomplish depends upon his determination and upon how well he has learned to systematize his day or his week. I am convinced that no college man, or university man either, can make real progress in research without setting apart a definite portion of his program for that exclusive purpose, and then sticking to it even to the extent of locking his doors, if necessary, against interruption while he is so engaged.

It often happens, however, that the worst intruder is one's own temptation to depart from his schedule. The research period arrives. There is a pile of test papers on his desk to be corrected, or a pile of ashes in his cellar to be carried out. Why not let the research go this week? After all, the research is only a side-issue. To minimize this, the writer has several times adopted the expedient of getting one or two college students to register for "advanced laboratory work" along the line of his own research, the laboratory period coming at regular scheduled

hours, and making it obligatory for the teacher to be on hand and to decline other engagements, which might otherwise be given precedence.

Such an arrangement adds zest to the work, in that it creates the atmosphere of mutual understanding and interest so much prized in the graduate school, and clarifies the teacher's own thinking as he explains the details to the students. It may afford, moreover, some little positive assistance, for there may well be parts of the routine experimental work or calculations that students can become skilful enough to perform with entire satisfaction. Several years ago, for example, I had on hand a piece of work in which an important part of the procedure was the repeated performance of very accurate weighings. I trained four students, at various times, in the theory of the balance and the practise of precise weighing, and while I prepared specimens, the students weighed them with as much skill and care as I myself could have done it. By no means the least benefit of this plan is its effect upon the student. No better training in perseverance and accuracy, no greater incentive to advanced study, no clearer insight into the real spirit of research, could be afforded the young learner than by this means. The realization that he is actually contributing to the sum of human knowledge is, to his developing nature, exhiliarating in the extreme. And best of all, no greater opportunity could be offered the teacher for that personal touch and influence which is the sacred privilege of the teacher's profession.

The research worker should make his work known. It is a most helpful thing to crystallize one's ideas from time to time in the form of connected statement, or better still, to keep a continuous written account of his procedure, his difficulties, and his results. To this end, he will find it of advantage to identify himself, by correspondence at least, with some not too distant university seminar, and contribute to its programs at suitable intervals in the form of research reports; to participate actively in the work of scientific organizations such as the Academy of Science, the American Physical Society, etc.; and to prepare his communications in suitable form for printing, at least in abstract. Another helpful feature is found in having a local scientific club, similar to the Baconian Club of this university or the Kelvin Society of Coe College, where people of somewhat kindred interest may get together and exchange experiences and catch something of one another's vision. In these ways the research worker gains the benefit of friendly encouragement and equally friendly criticism, and often has cause to appreciate the maxim that "two heads are better than one."

Above all, let us realize that we are never too old to learn, and that the most dangerous thing a teacher or a scientific man can do is to cease studying. Let the college scientist read books on new phases of his subject as they come out, even if he does not follow every technical detail, and even if he is obliged to borrow them from some university library for the purpose. Let him keep a classified card index of all the periodical literature available on his subject, noting especially articles that may suggest lines of investigation of particular interest to himself. Let him think beyond the daily topics of the classroom, let him mingle with practical men and get the bearing of his science on the affairs of the world. And what is most important, let him keep in touch with others of his calling, through visits and correspondence, so that in every possible way he may be open to the inspiration which comes with the pursuit of truth. For it is in these ways that the man who contributes to the welfare of mankind through scientific research lays his heavy foundations.

LeRoy D. Weld

Coe College,
Cedar Rapids, Iowa,

WAXY MAIZE FROM UPPER BURMA

A variety of maize introduced from Shanghai, China, in 1908, was found to have seeds with a new type of endosperm. In the seeds of this variety the texture of the starchy tissue is unlike that of any variety previously known. This new type of endosperm has been called waxy. Although distinct from other types, waxy endosperm is by no means

conspicuous, and since all the previously known types of endosperm are very widespread, essentially coextensive in fact with maize on the American Continent, it seemed not improbable that the existence of waxy endosperm in America had been overlooked.

With the hope of discovering the origin of this type of endosperm the collection of maize varieties in the Office of Crop Acclimatization was gone over with endosperm texture particularly in mind. The geographical distribution of the varieties examined was as follows: North America, north of Mexico, 369 varieties; Mexico, 152; Central America, 105; West Indies, 9; South America, 378; Europe, 60; Asia, 78; Africa, 22; Islands of the Pacific, 3.

The results of this investigation were entirely negative. The variety imported from Shanghai was the only one in which waxy endosperm was found. Not only was waxy endosperm absent from the American continent, but it appeared to be confined to the one locality in Asia.

In 1915 Mr. H. O. Jacobson was commissioned to make a special study of the distribution of the waxy type of maize in China. He found it at Tanyang near Suchou and at Táitsáng, but in both of these localities it was found to have been introduced from Liuho near Shanghai. Mr. Jacobson's observations are summarized in his report as follows:

1. The distribution of the waxy corn is very limited. When found away from Liuho, the original seed can be traced back to that community. Dr. Farnham states he noted the white waxy variety as Liuho fifty years ago.

2. The reason for limited distribution is that but little corn is grown in the immediate vicinity of Liuho, because it is not as profitable as other crops. Secondly, it is a poor yielder when compared with the varieties grown about Nanking, and, thirdly, it perhaps does not make as good "grits" as the corneous sorts.

3. I can not find any legend whatever. Among the farmers it is known by the usual name applied to maize and at Táitsáng, at least, no difference is made between the waxy and non-waxy.

4. At Táitsáng the non-waxy sort is cultivated, as well, and judging by the percentage of non-waxy seed ears saved, the waxy seed ears are very much in the minority.

No additional examples of this new type of endosperm came to light until late in 1915 when a few waxy seeds were found in a sample of maize collected for the Office of Foreign Seed and Plant Introduction by Mr. F. Kingston Ward in Upper Burma.

Breeding experiments showed the endosperm character from the two localities to be genetically identical. Independent origin seemed very unlikely nor was it probable that seed could have been imported from Shanghai into this remote region of Upper Burma. It was therefore assumed that although the sample contained but few waxy seeds, there must be somewhere in the Burma region, at least one locality where waxy maize was the prevailing type.

This expectation has been fully realized, the demonstration coming in the form of a collection of maize varieties recently received by the Office of Seed and Plant Introduction from Mr. E. Thompstone, Deputy Director of Agriculture, Northern Circle, Burma.

The collection consisted of 46 samples from the Northern and Southern Shan States and the Pokokku Hill Tract, most of the varieties with distinctive native names. Of the 46 samples twelve were found to have a horny endosperm, 19 a waxy endosperm and 8 were mixed. The remaining samples had been completely destroyed by insects.

One of the lots from the Southern Shan States consisted of eleven ears all of a uniform dark blue color and all waxy. Another sample consisted of 8 ears which were uniformly white, blue or pink, all of them having a waxy endosperm.

The discovery of this unique character of a plant of American origin in two isolated localities of Asia makes it of interest to learn something of the agricultural practises of the people growing this type of maize.

An excellent account of the various tribes of Upper Burma is given by Scott.[1]

From this and other official accounts it

[1] Scott, J. G., "Gazetteer of Upper Burma and the Shan States," 5 vols. Rangoon, 1901.

appears that the growing of maize is largely confined to the less civilized tribes living in the more mountainous and inaccessible parts of the country. Thus

The Tingpan Yoo are an agricultural people, but they cultivate only in the hills and not generally at a lower altitude than from 4,000 feet above sea-level. They grow paddy, cotton, maize and poppy.[2]

Another primitive tribe, the Wa, grow maize and buckwheat as their only crop plants. So isolated is this tribe that Mr. Scott, writing in 1846, makes the statement that

One British party has passed through the heart of the wild Wa country and they are perhaps the only strangers who have ever done so.

This isolation is due to the natural inaccessibility of the country which is six or seven thousand feet above sea level and exceedingly broken in character and to the dangers to which travelers are exposed from the natives. The Wa are still such ardent head hunters that few outsiders care to enter their country. Yet head-hunting with the Wa seems to be an agricultural rather than war-like practise. It is furthermore subject to certain restrictions as the following quotation shows:

Though heads are taken in an eclectic, dilettante way whenever chance offers, there is a proper authorized season for the accumulation of them. Legitimate head-cutting opens in March and lasts through April. The old skulls will ensure peace for the village, but at least one new one is wanted, if there is not to be risk of failure of the crops, the opium, the maize and the rice.[3]

In the Sagaing district, which is just south of Mandalay, maize is grown with lima beans, the maize plants serving as supports for the beans. This in one of the regions where the crop is grown for the husks rather than the grain.

When young the cobs are enveloped in large, soft, leaf-like sheaths. These sheaths, when dried, are known to Burmans as *pet* and are used as wrappers for Burmese cheroots. The production of *pet* is the most important use of the plant. The cobs or female inflorescences are rarely allowed to mature, unless when wanted for seed, but are boiled and eaten as a vegetable.[4]

In *Scott's Gazetteer* the husks, as cheroot wrappers, are repeatedly mentioned as the most important use of maize. It also appears that the native varieties are especially adapted to this purpose, thus it is stated that in Pakokku

American maize was grown for a time experimentally, but the husks proved too coarse for cheroot covers.[5]

We may therefore assume that the "Whackin white cheroot" of Kipling's Supi yaw lät was wrapped in the husks of waxy maize.

During the past season waxy endosperm has been discovered in still another part of Asia by Dr. W. H. Weston. Four ears grown at Los Baños in the Philippine Islands from seed originally from the Island of Mindanao were sent to the Department of Agriculture by Dr. Weston. All these ears contain a small percentage of waxy seeds.

At present there is no way of deciding whether this occurrence of waxy endosperm in the Philippines is the result of a recent introduction from Shanghai or whether it represents another of the early stations comparable with Burma and Shanghai.

Waxy endosperm has been used extensively in genetic experiments and has been crossed with all other known types of endosperm. It continues to behave as a single Mendelian unit inherited in a strictly alternative manner. It is in fact the only character of maize studied at all exhaustively, for which no modifying factors have been found.

The strictly alternative inheritance of waxy endosperm would suggest that it had originated through a single mutation. Parallel mutations are not uncommon but it is difficult to believe that the same mutation should have occurred independently in two localities

[2] *L. c.*, vol. I., Pt. I., p. 602.

[3] Scott, J. G., "The Wild Wa," *The Imperial Asiatic Quarterly Review*, 1896, p. 143.

[4] McKerral, A., Agricultural Surveys No. 2, Dept. of Agri., Burma, p. 10. 1911.

[5] *L. c.*, Pt. II., Vol. II., p. 723.

in Asia where maize is but little grown and should not have come to light on the American Continent where maize is cultivated so extensively and the varieties are so much better known.

If it is admitted that the waxy character is the result of a single mutation then all discussion of the time when it arose is of course idle, for a single mutation may have occurred as well at one time as another. There still remains the peculiar distribution of waxy endosperm and the differentation of other characters as evidence of the antiquity of the waxy mutation. The Shanghai variety in which waxy endosperm was first discovered possessed other peculiarities, the most conspicuous of these being erect leaf blades, monostichous arrangement of the upper leaf blades and an early development of silks while the ear is still enclosed in the leaf sheath. Unlike waxy endosperm, these characters are not definitely alternative in inheritence, but appear in varying degrees in crosses with varieties not showing these characteristics.

Although the expression of all these plant characters is variable even in the uncrossed waxy strain, pure stocks of this variety always present a distinctive appearance that immediately separates them from any other variety. It has been demonstrated that none of these plant characters is correlated with endosperm texture nor are any of them correlated with one another. It is, therefore, not surprising that the plants grown from the waxy seeds from Upper Burma did not resemble the Shanghai variety in any other particular. If the view that the waxy maize of Shanghai came originally from the region of the eastern Himalayas be accepted, we must conclude that sufficient time has elapsed since the introduction for the Shanghai variety to acquire its distinctive characters.

In the light of our present knowledge this unique character of an American plant appears to be confined to three isolated localities in Asia. Unfortunately, nothing is known regarding the maize varieties of Yunnan or other points along the route from Burma to Shanghai. If the waxy character originated in only one of these localities, however, it would seem much more reasonable to assume Burma as the region from which Shanghai received the character than vice versa. This is indicated by the inaccessibility of the region occupied by the Hill Tribes of Burma, the specialized uses of the plant, and the extensive series of named varieties.

The finding of this peculiar type of endosperm in the mountain region of Upper Burma supports the idea that maize entered China from the west instead of the east. This is in accord with the early Chinese accounts of maize as presented by Dr. Laufer. A more thorough knowledge of the maize varieties of the Himalayan regions promises to be the key to the distribution of maize in Asia.

G. N. COLLINS

BUREAU OF PLANT INDUSTRY,
DEPARTMENT OF AGRICULTURE

PHYSICAL MEASUREMENTS IN PSYCHOLOGY

THE recent article by Dr. Paul E. Klopsteg[1] on physical methods and measurements and the obligation of physics to other sciences, carries a strong appeal for those psychologists who are obliged to prepare students for research in the investigations of human behavior. The specialization found in the psychological laboratories is often merely due to the development of a special technique in physical measurements suited to a whole series of problems, rather than to a restricted psychological interest. Recent progress in psychological methods demonstrates very clearly that every problem dealing with the fundamental aspects of human behavior is also partly a physical problem. Much of the apparatus used in making measurements is "home-made" and while good results have been secured, it is equally true that better experimental results would be secured and much time saved if some expert in physical measurements, who is also interested in the

[1] SCIENCE, April 16, 1920, N. S., 51, 384–386.

application of objective methods to research work in psychology, were available when the apparatus is designed.

Under the present methods of preparing for a research problem requiring apparatus, the student in psychology begins to look through the literature to find how the phenomena that he expects to investigate were measured by other investigators. The original method of measurement may have been merely an accident of time, place and the available equipment. If the student is not mechanically expert, imitation is the only alternative. By the trial and error method, improvements do gradually develop but at a great loss of time and at the expense of accuracy and reliability.

While as a rule the men in physics show a fine cooperative spirit, students do not feel free to take up the time of a professor when such cooperation is not a regular part of the instructor's duties. The writer is not in sympathy with the view that better preparation in applied physical measurements should be given in the elementary course. Even the relatively extended course in "engineering physics" is little enough physics for the student in psychology. The problem of adequate training in physical measurements seems, to the writer, to belong to the graduate school, and should be as integral a part of the preparation of the science student as his preparation in foreign languages. The graduate faculty should support the department of physics in developing a course in applied physical measurements whose prime function is not that of teaching physical principles but that of preparing students to take advantage of the latest technical developments in physics. The more comprehensive the student's knowledge of the fundamental principles of physics, the better, but it must be recognized that the adjustment between physical principles and the principles of the other sciences, is always a compromise.

Perhaps one reason why courses in applied physical measurements have not been developed, although every scientist will admit their value, is because the graduate students of any one department do not form a large enough group to justify the expenditure of the necessary amount of money for the extensive equipment necessary to adequately carry on such a course. If, however, all the graduate students in the biological and physical sciences were gathered together under the direction of a high-class instructor, the time devoted to applied physical measurements would actually result in a saving of time and secure better cooperation from the department of physics than is usually accorded. Such a course should be in the hands of an instructor who is willing to keep abreast of what is going on in the other sciences. Such a man should be especially well grounded in general scientific theory so he can understand the problems of the other sciences. Developmental work in the applications of physical measurements to the other sciences should offer as good research opportunities as "pure" physics for the man whose interests are in the applied field. It is a mistake to assume that an expert machinist is the man wanted.

It must be recognized that the students taking applied physical measurements will probably not contribute directly to the advancement of physics. This implicitly may develop the attitude on the part of the professor in charge that these students are mercenaries who are commercializing physics. If this attitude is general in the department of physics, it is easy to see why no particular attempt is made to get the equipment and the type of instructor necessary to teach this work as satisfactorily as in the courses intended for students specializing in physics. It is the same attitude that is so often found in the instructors who are obliged to teach "scientific" German or French.

For students specializing in experimental psychology it is coming to be recognized more and more that in the work for the doctorate, training in the allied sciences and methods of physical measurements is quite as important as training in psychology. There is no danger that the student will neglect his psychology, but he may neglect important pre-

paratory courses unless they are taken before the doctorate is completed. Every psychologist recognizes his own limitations in applied physical measurements and a course as outlined by Dr. Klopsteg would do much toward extending the limits for the younger men.

In the writer's opinion the best time for taking such a course is before the student has begun experimental work on the problem which is to be the basis for his dissertation. At this time the question of method is uppermost and the problem has already been outlined. If the student is working on apparatus this is the time that the advice of the professor of applied physical measurements is of greatest benefit. These conditions arise in the first year of graduate work, or in a few cases, during the senior year. The course itself, however, should be under the supervision of the graduate school.

Of the seventeen types of physical measurements suggested by Dr. Klopsteg[2] the following would form an excellent background for the experimental psychologist: (1) The accurate measurement of long and short time intervals. (2) Measurement of temperatures by methods other than that of the mercury thermometer. (3) Temperature regulation and control. (4) Precision calorimetry. (5) The microscope and reading telescope. (6) Spectroscopic analysis. (7) Colorimetry and photometry. (8) The galvanometer. (9) Electrical measurements, both alternating and direct. (10) Graphic and smoke records.

With a practical knowledge of the use of these methods the student is qualified to undertake almost any problem in experimental psychology with the assurance that he is using the most approved methods of measuring his conditions and results.

A. P. WEISS

OHIO STATE UNIVERSITY

GENERAL WILLIAM C. GORGAS

WILLIAM CRAWFORD GORGAS, Surgeon General, U. S. Army, during the four years of the European War, 1914–18, and well-known for his work as chief sanitary officer of the Panama Canal, died in London on the early morning of July 4, in the sixty-sixth year of his age. He had sustained a stroke of apoplexy on May 29, lingering for more than a month in hospital with some hope of recovery, but renal complications intervened and he passed away in unconsciousness.

General Gorgas was born at Mobile, Alabama, on October 3, 1854. He was the son of General Josiah Gorgas, Chief of Ordnance of the Confederate Army, and received his earlier education in the South, graduating from the University of the South in 1875. He then went to New York to study medicine, and received his medical degree from Bellevue Hospital Medical College in 1879. He was intern at Bellevue Hospital during 1878–80, and in the last year of his residence in hospital, took an examination for admission to the Medical Corps of the U. S. Army, receiving his commission as surgeon on June 16, 1880. He was promoted captain in 1885 and during the Spanish-American War, served as a major and brigade surgeon of volunteers, receiving his majority in the Regular Army on July 6, 1898. At the close of the Spanish-American War, he was appointed Chief Sanitary Officer of Havana, holding this position from 1896 until 1902. In connection with this important detail, it fell to his lot to apply to the sanitation of Havana the discovery of the late Major Walter Reed, that yellow fever is transmitted by mosquitoes, which was accomplished by Reed, as the head of an Army Board sent to Cuba to investigate yellow fever in 1900–1901. In February, 1901, shortly after Reed's discovery was established, Gorgas began to screen yellow fever patients and to destroy fever-bearing mosquitoes by oiling the surface of all pools or collections of water where they were likely to breed. In three months time, Havana was freed from yellow fever for the first time in nearly two centuries. For this work in eliminating the disease from Havana, Gorgas was made a colonel and assistant surgeon general by special act of Congress on March 9, 1903. On March 1, 1904, he was appointed chief sanitary officer

[2] SCIENCE, April 29, 1919, N. S., 50, 199–202.

of the Panama Canal, where he carried out the same line of work in the cleaning up the Isthmus. When the French, under de Lesseps, began to work on the Panama Canal in 1880, the Isthmus was one of the plague-spots of the world and during their nine years of occupation, they lost 22,189 laborers from disease. When the United States government took charge of the Canal in 1904, the death rate was high and a yellow fever epidemic was going on. In less than a year yellow fever was wiped out and there has not been a single case since May, 1906. Gorgas was made a member of the Isthmian Canal Commission in 1907, and remained in charge of sanitation until the winter of 1913, when he went to South Africa, at the invitation of the Chamber of Mines of Johannesburg, to investigate the high death rate from pneumonia among the natives working in the mines of the Rand. By applying the army methods of increasing the air space of sleeping quarters the death rate was materially lowered. He was appointed surgeon general of the U. S. Army on January 16, 1914, and was given the rank of major general in 1915. In 1916, he spent several month in South America in making a preliminary survey of localities still infested with yellow fever the "endemic foci" of the disease, for the Rockefeller Foundation. Upon his retirement from active duty in the Army in the fall of 1918, he resumed this work and had just started upon an investigation of the African foci at the time of his death. If completed, this work may result in the eradication of yellow fever from the globe. General Gorgas conducted the administration of the Surgeon General's Office in Washington during the war period, and shortly before his retirement, accompanied the secretary of war to France. He was a member of many medical societies and received many honors during his life. He was awarded gold medals by the Liverpool School of Tropical Medicine in 1907, by the American Museum of Safety in 1914, and shortly before his death was decorated by King Albert of Belgium and knighted by King George IV. In March, 1914, he received the degree of doctor of science from the University of Oxford. General Gorgas was a man of attractive character, and highly popular with the medical profession. In 1885, he married Miss Marie C. Doughty, of Cincinnati, Ohio, who survives him with a daughter. He was the author of many articles on the subject of yellow fever.

M. W. IRELAND,
Surgeon General, U. S. Army

SCIENTIFIC EVENTS

THE ANNUAL REPORT OF THE REGISTRAR GENERAL OF ENGLAND AND WALES

THE eighty-first annual report of the Registrar General which deals with the births, deaths and marriages in England and Wales for the year 1918, has been issued.

According to an abstract in the London *Times* the report shows that the marriage rate was 15.3 per 1,000, being 1.5 above the low rate in the preceding year (13.8), and 0.1 below the average in the last 10 years, 1905–1914, which were unaffected by war conditions (15.4). The provisional figures for 1919 indicate a further rise to 19.7 per 1,000, the highest rate on record.

The birth-rate in 1918 was 17.7 per 1,000, being the lowest on record. This rate was 0.1 per 1,000 below that recorded for 1917, and 6.1 below that for 1914, which, particularly so far as the birth-rate was concerned, might be regarded as the last year unaffected by war conditions. Even this large reduction, however, amounting in all to nearly 26 per cent. in 1918 as compared with 1914, was believed to compare very favorably with the experience of other belligerent countries. The provisional figures for 1919 indicate a recovery, showing an increase of 0.8 per 1,000.

The civilian death-rate in 1918 was 17.6 per 1,000, being 3.2 above the rate in the preceding year. The increased mortality was due to the epidemic of influenza. Apart from this, the year was one of extraordinary healthiness. The provisional figures for 1919 indicate a fall of about 3.8 per 1,000, notwithstanding the continuance of the epidemic into the early part of the year.

Infantile mortality was 97 per thousand

births, being one per thousand above the rate in the preceding year, but 10 per thousand below the average of the 10 years 1908–17. It is one of the four lowest rates hitherto recorded. The provisional figures for 1919 show a rate of 89 per thousand births, or two per thousand births below that of 1916, which at 91 per thousand was the lowest hitherto returned.

The estimate of the total civilian population for the whole of England and Wales is given as 13,777,100 civilian males and 19,697,600 females, making a total of 33,474,700 persons. The marriages during the year numbered 287,163, and the marriage rates of 51.9 for males and 41.0 for females represented a considerable advance on the low records of the previous year.

The births registered during 1918 numbered 662,661, or 5,685 fewer than in the previous year, during which 210,750 fewer births had been registered than in 1914, while the deaths of 611,861 were registered during the same period. Of the deaths, 314,704 were of males and 297,157 of females. The males included 24,033 non-civilians.

THE WORLD'S PRODUCTION OF GOLD

THE Geological Survey has given out some preliminary figures showing the promotion of gold throughout the world in 1919. The production in the United States was $58,285,196; Canada is reported to have produced $14,687,000; India $10,028,000; Australia (not including New Zealand or the Islands), $29,268,000; the Transvaal, $171,640,123; Rhodesia and West Africa, $18,631,070. There was a probably large decrease in the production of gold in Russia and Siberia in 1919. Some increase was probably made in the output of Central America and South America, which however, was doubtless offset by decreases in the output of other countries. The incomplete returns now available indicate that the world's production of gold in 1919 was between $345,000,000 and $350,000,000. The world's production in 1918 amounted to $380,924,500.

The survey further states that information received during the first six months of 1920 indicated a still further decrease in the production of gold in the United States and that the output for the year will probably be less than $50,000,000. The production in Alaska, Colorado, California, Oregon and Montana will be much less in 1920 than it was in 1919, because water is very short for placer mining and many stamp mills are closed. Canada as a whole may increase its output, although the production of the Yukon districts will be smaller than last year. The output of Russia can not be estimated. That of Australia will show a decrease. That of South Africa and South America will probably show no radical decrease. According to the survey the indications are that the decrease in the world's production of gold in 1920 will not be so great as it was in 1919.

PROFESSOR VAN BENEDEN OF LIÉGE

A LIFE-SIZED bronze statue of Van Beneden, professor of zoology in the University of Liége, who died four years ago, was unveiled on May 24. The statue stands at the entrance to the Zoological Institute where Van Beneden worked and taught for over thirty years. We learn from the *British Medical Journal* that the ceremony was attended by a large number of his old colleagues, by representatives of other Belgian universities and scientific societies, and by delegates from British universities. Both King Albert and the Belgian Parliament were represented. The representatives of the British universities were Professor Sarolea (Edinburgh), Sir Leslie Mackenzie, of the Local Government Board of Scotland (Aberdeen), and Professor Sir Thomas Oliver (Durham). Professor R. W. Hegner, represented the Johns Hopkins University, Baltimore. When fully mustered the company marched in procession to the class-room where Van Beneden had taught and in which was gathered a large number of old and present students and his widow and relatives. The Rector was in the chair. Dr. Nolf, professor of pathology in the university, delivered a memorial address, during which a beautifully executed bronze mural tablet, pronounced to

be an excellent likeness, was unveiled. Professor Gravis (botany), M. Lameere (president of the Belgian Royal Academy of Science), Professor Van der Stricht (Ghent), Professor Sarolea (Edinburgh), and Professor Ditmas, successor to the late professor, delivered addresses containing references to the epoch-making researches of the great embryologist and his work upon fecundation and cell reproduction. The speaker who drew the greatest applause was Van der Stricht, who, while pleading for the University of Ghent, insisted upon it retaining its French character as opposed to a purely Flemish institution. When he had finished his address the Rector, rising amidst the applause of the audience, kissed the distinguished Fleming upon both cheeks. Afterwards the audience proceeded to the front entrance, where the full-sized statue in bronze was unveiled. A luncheon, attended by several of the delegates and the rector of the university, followed.

THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH

THE board of scientific directors of the Rockefeller Institute for Medical Research announces the election of Dr. Winthrop J. V. Osterhout as a member of the board of scientific directors to succeed Dr. Theodore C. Janeway, deceased.

The following promotions and appointments are announced:

Dr. Alfred E. Cohn, hitherto an associate member in medicine, has been made a member.

Dr. Peyton Rous, hitherto an associate member in pathology and bacteriology, has been made a member.

Dr. Donald D. Van Slyke, hitherto an associate member in chemistry, has been made a member.

Dr. Francis G. Blake, hitherto an associate in medicine, has been made an associate member.

Dr. John H. Northrop, hitherto an associate in experimental biology, has been made an associate member.

Dr. James H. Austin, hitherto an assistant in medicine, has been made an associate.

Dr. Harry W. Graybill, hitherto an assistant in the department of animal pathology, has been made an associate.

Dr. William C. Stadie, hitherto an assistant in medicine, has been made an associate.

The following have been made assistants:

Miss Helen L. Fales (chemistry).

Dr. Philip D. McMaster (pathology and bacteriology).

Miss Marion L. Orcutt (animal pathology).

The following appointments are announced:

Dr. Harry Clark, associate member in pathology and bacteriology.

Dr. Pierre L. du Nouy, associate member in experimental surgery.

Dr. Paul H. de Kruif, associate in pathology and bacteriology.

Dr. Lloyd D. Felton, associate in pathology and bacteriology.

Dr. Rudolf W. Glaser, associate in the department of animal pathology.

Dr. Carl A. L. Binger, assistant in medicine.

Dr. Ralph H. Boots, assistant in medicine.

Dr. Louis A. Mikeska, assistant in chemistry.

Dr. Charles P. Miller, Jr., assistant in medicine.

Dr. Eugene V. Powell, assistant in X-ray.

Dr. Leslie T. Webster, assistant in pathology and bacteriology.

Dr. Goronwy O. Broun, fellow in pathology and bacteriology.

Miss Katharine M. Dougherty, fellow in pathology and bacteriology.

Mr. Thomas J. Le Blanc, fellow in pathology and bacteriology.

Dr. Giovanni Martinaglia, fellow in the department of animal pathology.

Mr. Henry S. Simms, fellow in chemistry.

Dr. Marshall A. Barber, hitherto an associate in pathology and bacteriology, has accepted a position with the U. S. Public Health Service to do field work in the Malaria Research Laboratory, Memphis, Tennessee.

Miss Angelia M. Courtney, hitherto an associate in chemistry, has accepted an appointment to do chemical work in the Medical School of the University of Toronto.

Dr. Carl Ten Broeck, hitherto an associate in the Department of Animal Pathology, has accepted an appointment as associate professor of bacteriology with the Peking Union Medical College.

Mr. Earl P. Clark, hitherto an assistant in

chemistry, has accepted a position with the Bureau of Standards, Washington, D. C.

Dr. Ferdinand H. Haessler, hitherto an assistant in pathology and bacteriology, has accepted an appointment as resident pathologist in the Department for Nervous and Mental Diseases in the Pennsylvania Hospital at Philadelphia.

Dr. Arthur B. Lyon, hitherto an assistant in medicine, has resigned to enter private practise.

SCIENTIFIC NOTES AND NEWS

THE University of Wisconsin has conferred the degree of doctor of laws on Dr. Alonzo E. Taylor, professor of physiological chemistry, at the University of Pennsylvania, and the degree of doctor of science on Dr. Joel Stebbins, professor of astronomy at the University of Illinois.

THE degree of doctor of science was conferred on Dr. C. C. Adams, director of the Roosevelt Wild Life Forest Experiment Station at the college of forestry of Syracuse University by Illinois Wesleyan University, on the twenty-fifth anniversary of its founding.

PROFESSOR JOHN W. TOWNEY, dean of the Yale Forest School received the degree of LL.D., at the commencement exercises of the New York State College of Forestry at Syracuse University.

THE University of Vermont has conferred the degree of LL.D., on Dr. Edward G. Spaulding, professor of philosophy in Princeton University.

THE University of St. Andrews has conferred the degree of LL.D., on Dr. Leon Fredericq, for nearly forty years professor of pathology in the University of Liége, Belgium; on Mr. W. J. Matheson, president of the biological laboratory of the Brooklyn Institute, and scientific adviser in chemistry to the Board of Health for the city of New York, and on Dr. Norman Walker, inspector of anatomy for Scotland and direct representative of the profession in Scotland on the General Medical Council, and on Dr. Norman Kemp, Smith professor of logic and metaphysics at the University of Edinburgh.

THE Association of American Physicians has elected as honorary members: Sir Clifford Allbutt, University of Cambridge, M. Roux, until recently director of the Pasteur Institute, Paris, Professor Heger of Brussels, and Professor Marchiafava of Rome.

AT the meeting of the Linnean Society on May 27 the gold medal of the society was handed by the president to Sir Ray Lankester, to whom it had been awarded by the president and council.

DR. J. G. ADAMI, vice-chancellor of the University of Liverpool, and lately Strathcona professor of pathology and bacteriology in McGill University, has been elected to an honorary fellowship at Christ's College, Cambridge, of which he was formerly a scholar.

DR. E. F. LADD, president of the North Dakota Agricultural College, and previously professor of chemistry, has been nominated by the Republican party for the senate in place of Senator Gronna. Dr. Ladd was the candidate of the Non-Partisan League.

DR. HENRY KRAEMER, dean of the school of pharmacy of the University of Michigan, has resigned. He will continue his investigations on the cultivation of medicinal plants and the nature and distribution of color in plants.

DR. E. F. NORTHRUP has resigned from Princeton University as assistant professor of physics, having been elected vice-president and technical adviser of the recently organized Ajax Electrothermic Corporation, of Trenton, N. J., which manufacturers the high frequency induction furnace which he developed in the Palmer Physical Laboratory.

DR. E. W. GUDGER, after fourteen years service as professor of biology in the North Carolina College for Women, Greensboro, N. C., has resigned. During the coming year he will be at the American Museum of Natural History, associated with Dr. Bashford Dean as editor of Volume III. of the Bibliography of Fishes, Volumes I. and II. of which have already appeared.

T. Nelson Dale, geologist of the United States Geological Survey and author of bulletins on the Economic Geology of Slate, Granite and Marble, owing to the "Retirement Act," will, on August 21, 1920, take up the work of a consulting geologist in problems pertaining to slate, granite, marble, lime-rocks and the drilling for water.

Dr. Walter A. Ver Wiebe, formerly connected with the geological faculties of Cornell University and the Ohio State University, and more recently field geologist for the Roxana Petroleum Company of Tulsa, has been chief geologist for the Mexican Sinclair Petroleum Corporation since April of this year, with headquarters in Tampico.

Dr. T. S. Taylor, who has, during the first part of the present calendar year, been in charge of the research work for the Magnesia Association of America at the Mellon Institute of Industrial Research, University of Pittsburgh, Pittsburgh, Pa., returned on July 1 to the Research Laboratory of the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., to take charge of their thermal research.

Mr. Earl Stafford has become a member of the engineering staff of Arthur D. Little, Incorporated, chemists and engineers, Cambridge, Mass. Mr. Stafford is a graduate of the engineering school of Tufts College, 1908, and for the past twelve years has devoted his attention largely to hydro-electric developments with particular reference to ore treating plants, pulp and paper mills and light and power companies.

Dr. George H. Parker, professor of zoology, has been appointed Harvard exchange professor for next year to the western colleges.

The commencement address at the University of South Dakota, on June 21, was given by Dr. George F. Swain, of Harvard University, the subject being "The Dangers of Idealism."

The Halley lecture at Oxford is to be delivered this year by Professor R. A. Sampson, astronomer royal for Scotland.

In memory of the late Major-General William C. Gorgas, funeral services under the auspices of the British government were held in St. Paul's Cathedral on July 9. Troops escorted the body to the cathedral and a military salute was fired at Hyde Park as the procession filed along the street from Queen Alexandra's Military Hospital to St. Paul's. Pall bearers included presidents of the Royal College of Physicians and the Royal College of Surgeons, and the director of the British Army Medical Service.

Dr. E. Mead Wilcox, director of the Agricultural Experiment Station and College of Agriculture in Santo Domingo, is in the United States for the purpose of securing additional men for his staff and the selection of laboratory equipment. He desires to secure a horticulturist, plant pathologist, chemist, veterinarian, and animal husbandryman and will be glad to enter into correspondence with persons interested. In addition to special knowledge of the particular subject some knowledge of Latin, French or Spanish is essential. Correspondence should be directed to him in care of Arthur H. Thomas Company, Philadelphia, Pa.

Mr. John D. Rockefeller, Jr., has given the new management of the New York State Reformatory for Women in Bedford the use of the social hygiene bureau and laboratory situated alongside the institution, for the study and scientific treatment of prisoners. The laboratory was built and equipped at a cost of $200,000. Mr. John S. Kennedy, president of the State Prison Commission, recently urged that the laboratory be taken over. It was closed four years ago when Miss Helen A. Cobb, recently resigned, became superintendent of Bedford Reformatory. Miss Florence Jones, the new superintendent, and Dr. Phyllis Blanchard, who has been appointed psychiatrist, were in conference in relation to the psychiatric work. Mr. Rockefeller has consented to let the new administration use the laboratory at a rental reported to be $1 a year.

The program of the eighth annual meeting of the Eugenics Research Association, held at

Cold Spring Harbor, on June 25, was as follows: President Stewart Paton's address: "Democracy's opportunity." R. H. Johnson: "Some eugenical aspects of the distribution of wealth." Madison Grant: "The present racial outlook in the world at large." A. H. Estabrook: "The eugenical bearing of psychological work of the army." A. J. Rosanoff: "Preliminary report of a study of the prevalence of chronic psychoses in the population of the State of New York." Anna M. Peterson: "The eugenical aspect of custodial institutions for women." F. Stuart Chapin: "The scientific aspects of field work in the social sciences." C. B. Davenport: "Heredity of twins." H. H. Laughlin: "The eugenical provision of the constitution of the German republic."

FREE public lectures are being delivered in the lecture hall of the Museum Building of the New York Botanical Garden, Bronx Park, on Saturday afternoons, at four o'clock, as follows:

July 17. "Spoilage of fruits and vegetables during transportation and storage," F. C. Meier.

July 24. "The state park at Devil's Lake, Wisconsin," Dr. A. B. Stout.

July 31. "Flowers for the summer garden," G. V. Nash.

August 7. "Diatoms—plants of beauty seen through a microscope," Dr. M. A. Howe.

August 14. "Through the Philippines with a kodak," Dr. H. A. Gleason.

August 21. "How to know, gather and cook the puffballs," Dr. W. A. Murrill.

August 28. "A trip to Colorado," Dr. F. J. Seaver.

In order to provide a method for viewing the collections of the garden under guidance, a docent leaves the front door of the museum building every week-day afternoon at 3 o'clock, to escort all who may wish to accompany him. The routes are as follows: Monday: Hemlock Forest, Mansion and Herbaceous Garden. Tuesday: Pinetum. Wednesday: Fruticetum and North Meadows. Thursday: Deciduous Arboretum, Public Conservatory Range 2, Nurseries, and Propagating Houses. Friday: Public Conservatory Range 1. Saturday: Museums.

UNIVERSITY AND EDUCATIONAL NEWS

DR. RODNEY HOWARD TRUE, of the U. S. Department of Agriculture, has been appointed professor of botany in the University of Pennsylvania, to succeed Dr. John M. Macfarlane, who recently resigned.

DR. WALTER TAGGART has been appointed Blanchard professor of chemistry and director of the chemical laboratory of the University of Pennsylvania, to succeed Dr. Edgar F. Smith.

DR. H. R. KRAYBILL, of the Bureau of Plant Industry, has been appointed professor of agricultural chemistry and head of the department of chemistry of New Hampshire State College.

ADDITIONAL appointments in Colorado College for 1920–21 include, as assistant professor of geology, Mr. I. A. Keyte, B.S. (Missouri), recently head of science work in the Colorado Springs High School, and, as instructor in physics, Mr. Elmer Furnquist, A.M., (Illinois), recently an instructor in that institution.

REINHOLD F. A. HOERNLE, assistant professor of philosophy at Harvard University, has resigned in order to accept a professorship at Durham University.

DR. W. J. DAKIN, professor of biology in the the University of Western Australia, has been appointed to the Derby chair of zoology, University of Liverpool, in succession to the late Professor Leonard Doncaster. Dr. I. M. Heilbron, professor or organic chemistry at the Royal Technical College, has been appointed to the chair of organic chemistry.

DR. BENJAMIN MOORE, of the research staff at Oxford, has been appointed to the new chair of biochemistry.

DISCUSSION AND CORRESPONDENCE

INTERSEXES IN DROSOPHILA AND DIFFERENT TYPES OF INTERSEXUALITY

TO THE EDITOR OF SCIENCE: In your issue of March 26, 1920, there appeared an important article by Dr. Sturtevant, in which he proved that intersexuality may be produced in

Drosophila simulans by the action of a mutant gene. He concludes with the remark:

> It has been assumed by Goldschmidt, Hertwig, Banta, and others working with intersexes that in their animals the normal sex-determining mechanism itself was failing to function as usual. The present example shows that such an assumption can not be accepted without proof.[1]

May I be allowed to point out some very important distinctions between this present example and the best worked-out of the others, namely Goldschmidt's intersexual moths (*Lymantria*). (1) Sturtevant's intersexual *Drosophila* are all females. Goldschmidt has obtained intersexes in both sexes. (2) The gonads in Sturtevant's example are described as "minute, if present." In *Lymantria*, instead of such marked reduction occurring, the gonad is transformed, partly or wholly, into that typical of the other sex. (3) Most important of all, Sturtevant's flies appear to be all of one type or grade of intersexuality. Goldschmidt's moth intersexes, both male and female, form a continuous series from normality to complete sex-reversal. (4) Goldschmidt's analysis of his material has shown that the *Lymantria* intersexes are zygotes which have started development as individuals of one sex, but at a given point have been switched over to continue as individuals of the other sex. The degree of intersexuality depends on the point of time in development at which the change occurs. It is essential to have an analysis of the *Drosophila* case from this point of vew, before further comparison is profitable. (5) When a highly intersexual female *Lymantria* which is functional as a male is mated with a normal female, the sex-ratio in the resulting broods is what would be expected if both parents were of Z W chromosome constitution; the same is true when, instead of high-grade intersexes, such individuals of all male broods as must be supposed to be transformed females are bred from.

With these differences between the intersexuality of *Drosophila* and that of *Lymantria*, we can not be sure that the two are quite comparable, or due to the same set of causes. In conclusion, it may be said that the Columbia School itself has made it exceedingly probable that the function of the sex genes is normally to initiate one series when present in two doses; the one series of reactions allowing of the appearance of the structures and instincts of one sex, the other of those of the other sex. If this is so, then there is theoretically nothing whatever against the possibility of these series of reactions, and the physiological states to which they give rise being altered, (1) by the mutation of independent genes (as appears undoubtedly to be the case in *D. simulans*); (II) by an alteration in the balance between the sex-genes and other factors influencing development, (as would seem more than probable in *Lymantria*); or, (III) by external agencies (as apparently in Hertwig's and Kuschakewitsch's experiments on frogs and Miss King's on toads). The burden of proof, in the present state of our knowledge, lies even more on the upholders of gene-produced intersexuality than on the upholders of the balance theory, but quite possibly both are right.

JULIAN S. HUXLEY

NEW COLLEGE, OXFORD,
May 1, 1920

[1] To this list should be added Harrison, *Jour. Genetics*, 9, 1919, p. 1.

THE ORIGIN OF OIL

A. W. McCOY has published in *Journ. Geol.* XXVII. (1919), pp. 252–262, evidence that crushing oil shale converts some of the solid organic matter into oil. The conditions of the experiment seem to preclude any chance for much general heating of the mass of shale used.

Can some mathematical physicist tell us whether a strain or shear would cause a high temporary temperature at the point of rupture? The heat would be absorbed by the adjacent rock and would not greatly increase the temperature of the whole mass, unless the quantity of heat were large. Yet the temperature at some points *might be* high enough for a very short time to cause the dissociation of the organic molecules adjacent

to these points. The effect probably would be concentrated on the surfaces of maximum strain and shear.

The results of this enquiry may be of fundamental significance in theories of the origin of oil. The writer will appreciate any information thereon.

CHESTER W. WASHBURNE
60 LIBERTY STREET,
NEW YORK CITY

THE CAUSES AND PREVENTION OF AFTER CORROSION ON THE BORES OF FIREARMS[1]

THE report of an experimental study, containing also a careful review of the scientific, patent, and trade literature and a compilation of empirical experiences which have variously attributed after-corrosion on oiled bores as due to powder acids, diffusing gases, primer acids, metal fouling, and chlorides.

Humidity relations, chemical examination of the corrosive residue, special ammunition, and a study of many so-called "gun oils" and "nitrosolvents" showed:

The infantry service cartridge leaves no nitrocellulose or acid residue. The after-corrosion is caused by (1) the deposition of a water soluble salt or salts capable of giving corrosive solutions, (2) the presence of a humidity high enough to form a liquid film, and (3) the presence of oxygen. In the service ammunition, the decomposition of the chlorate of the primer furnishes the only water soluble salt. Pits and tool wounds retain this, so that it can not be removed mechanically. It may be dissolved by water. Corrosion may also be prevented by stoppering the bore or by altering the composition of the primer. A number of the non-aqueous compositions sometimes recommended for cleaning rifles are of no value. Their virtues apparently rest on tests conducted at humidities so low that no corrosion could occur.

The paper is illustrated with photographs and photomicrographs. It presents a simple test for differentiating between worthless and useful "nitrosolvents" and also discusses the corrosive effects of black powder and low pressure nitrocellulose powders.

WILBERT J. HUFF[2]
BUREAU OF MINES,
WASHINGTON, D. C.

[1] Published by permission of the director of the U. S. Bureau of Mines.

[2] Chemist, Pittsburgh Experiment Station, Bureau of Mines.

SCIENTIFIC BOOKS

An Introduction to Entomology. By JOHN HENRY COMSTOCK, Professor of Entomology and General Invertebrate Zoology, Emeritus, in Cornell University. Ithaca, N. Y., Comstock Publishing Company. 1920, xviii + 220 pages, 220 figs.

The dean of American entomologists has just issued the first part of a second edition, entirely rewritten, of his long-known text-book called "An Introduction to Entomology." It covers the structure and metamorphosis of insects, and it covers these subjects in such complete and thoroughgoing way and, at the same time, in such compact manner, as to make the book by all odds the very best of extant texts to put into the hands of entomological and zoological students. It will be indispensable for beginning students; it will be very useful for advanced ones.

Such large compendiums as Berlese's (as yet only available in the original Italian), and Sharp's (in the English "Cambridge Natural History") and Packard's "Text-book of Entomology," are all of a character which limits their use in the laboratory to that of reference books; they are too extended and expensive, to say nothing of their less adapted organization and general make-up, to permit their use as actual individual laboratory handbooks. Comstock's book fills exactly the long-felt need. It contains all the knowledge up to the very present, carefully analyzed, sifted, and a great part of it actually contributed or tested by Comstock and his students, that the general student of insect structure and post-embryonic development needs to know. And it is all packed away, in perfect arrangement, with elaborate analytical contents, sufficient index and bibliography and carefully chosen illustrations, in about two

hundred pages, clearly printed on good paper, and substantially bound in convenient format. The experience of a veteran text-book maker and user shows in every feature of this book's construction.

The new book is "affectionately inscribed" to the author's "old students whose youthful enthusiasm was a constant inspiration" during a long period of service as teacher, as an effort to further aid them, though they are now gone from his classrooms and laboratories. Professor Comstock may rest assured that his greeting will be quite as affectionately returned, and that his latest effort will be as gratefully received by his many scattered students, mostly now no longer youthful, as were his earlier efforts to instil in them that love of nature and passionate interest in learning to know nature's works which have been for so many years beautifully characteristic of their beloved mentor. These old students will be greatly helped by this effort in their attempts to carry on to new students the Comstock tradition. And American entomology has not had, nor will ever have, any finer tradition.

VERNON KELLOGG

SPECIAL ARTICLES

"PHYSICAL CONSTANTS" PERTAINING TO THE OCEAN

An important object of the science of physics is description of the behavior of different substances. Expression in mathematical form of such descriptions requires the use of one or more "physical constants," such as the coefficient of elasticity, conductivity, etc. Constants thus obtained are generally regarded as intrinsic, or peculiar to the substance. The extensive list of "physical constants" already determined bears witness to the achievements of physics, and constitutes fundamental quantitative data of the science.

Application of the methods of physics to terrestrial phenomena taking place on a correspondingly immense scale, has likewise resulted in physical laws or descriptions capable of expression in mathematical form. But the corresponding "physical constants" can not be evaluated by means of experiments necessarily limited to much smaller dimensions. The influence of the enormous magnitudes involved in many terrestrial phenomena can be determined only by observing the phenomena as they take place in nature. It is impossible, for example, to determine in detail the motion of the water particles in the convective circulation of even a limited part of the sea. But this would be necessary in order to resolve the water mass into sufficiently small portions to justify the assumption, made in laboratory experiments, of flow in plane layers. Even if this resolution of the complex motion into its elements were possible, there would still be the impracticable task of summing up the effects of the correspondingly complex and irregular system of forces in order to obtain the resultant effect. The only recourse is to observe the system as a whole under the actual conditions of the sea. For example, a decade ago, the Swedish physicist, V. W. Ekman, applied the classical hydrodynamical equations to certain ocean current observations, but replaced the viscosity coefficient by a constant representing the integrated effect of the complex system of frictional forces. The value of this constant is thousands of times greater than the coefficient of viscosity of sea-water. A generation ago, a German mathematician, Zöppritz, developed an elaborate mathematical theory of ocean currents, but used laboratory values of the physical constants. Consequently his theory disagreed widely with subsequent objective knowledge. Such results emphasize the fact that physical constants are dependent not only upon the nature of the substances, but also upon the corresponding external conditions, and must therefore be determined under the conditions prevailing where they are to be used.

Progress in laboratory investigations is continually demonstrating the variability of quantities originally regarded as physical constants. Further refinement often requires the substitution of a variable, dependent upon additional conditions, for constant quantities of earlier formulæ. This is also true in

cosmic and terrestrial physics. Continuous and highly refined observations on the sun have demonstrated the variable nature of the "solar constant." The so-called constants of heat conductivity, diffusion, viscosity, etc., pertaining to the ocean also vary with the conditions, though they are all thousands of times larger than the corresponding laboratory values.

For example, to determine the upwelling velocity in the southern California coastal region the author applied the classical equation[1] for the diffusion of salts in a medium moving with the velocity W, to seasonal observations of ocean salinities at a series of depths, and obtained the value 40 in C.G.S. units for the diffusion constant μ^2, while a Norwegian investigator, Jacobsen, obtained values varying from 0.3 to 11.4 for different regions of the sea near Denmark. The laboratory value for the diffusion coefficient of ocean salts in water is only .0000125. The upwelling velocity in the southern California region was also determined by applying to serial ocean temperatures Fourier's equation for the flow of heat in a moving medium. The conductivity constant for this ocean region was found to be 30, while the laboratory value of the coefficient of conductivity of sea-water is only .0012.

The values of such constants found under the simple conditions of laboratory control are known to depend upon the temperature of the fluid. This is in turn an index of the complex molecular activity. In the ocean, the corresponding variable factor is the rate of interchange of small parts of the water in the ever present alternating convective circulation.

Complicated as those phenomena are, encouraging results have already come from quantitative studies, not only in oceanography, but also in other geophysical investigations.

GEORGE F. MCEWEN
SCRIPPS INSTITUTION FOR
BIOLOGICAL RESEARCH,
UNIVERSITY OF CALIFORNIA

[1] Ocean temperatures, their relation to solar radiation: quantitative comparisons of certain empirical results with those deduced by principles and methods of mathematical physics by George F. McEwen, 1919, Semicentennial Publications of the University of California, 1868–1918, pp. 336–421, 19 figs. in text.

THE DIFFERENTIAL STAINING OF PLANT PATHOGEN AND HOST

THE well-known difficulty experienced in staining to differentiate pathogen from host tissues in phytopathological studies needs no comment. In order to obviate this difficulty the writer has tried numerous combinations of stains and finally a method was hit upon which gives uniformly satisfactory results from the histological point of view. It is not intended for cytological studies although even for these there may be possibilities in the method.

The comparatively short time required to complete preparations, and the fact that students not yet expert in microtechnique can in most cases obtain good mounts, decided the question of publication.

STAINS

1. Magdala red. A 2 per cent. solution in 85 per cent alcohol.
2. Licht grün. A 2 per cent. solution in clove oil to which has been added a few drops of absolute alcohol.

METHOD

1. Dissolve paraffin in xylol and wash in absolute alcohol.
2. Wash in 95 per cent. and 85 per cent. alcohols.
3. Stain with Magdala red 5 to 10 minutes.
4. Remove surplus stain and wash in 95 per cent. alcohol.
5. Stain with Licht grün in clove oil for 1 to 3 minutes.
6. Wash in absolute alcohol, or in carbol-turpentine.
7. Clear in xylol and mount in Canada balsam.

The time factors may require slight modifications in some cases but a microscopic examination of the slide will enable the worker easily to determine the variation required. As a rule the staining with Licht grün is very rapid and if overstaining occurs the red becomes tinged with purple although this may

not impair the visibility of the mycelium. In completed preparations the mycelium, spores, amoebæ or bacteroidal tissues are a brilliant red and host tissues green. This combination gives clear differentiation for visual microscopic study but for photomicrography the use of filters is necessary.

If sections are somewhat resistant to staining good results are obtained by first mordaunting them in a 1 per cent. solution of potassium permanganate in water for 2 to 5 minutes, afterwards washing in water and passing through graded alcohols to 85 per cent. The mordant must be freshly prepared as it will not keep.

Excellent preparations have been obtained with the following phytopathological material: *Plasmodiophora brassicæ*, legume tubercles, *Albugo candida*, *Phytophthora infestans*, *Plasmopara viticola*, *Exoascus pruni*, *Mycosphaerella rubina*, *Venturia inaequalis*, *Cronartium ribicola*, *Peridermium balsameum*, *Uromyces caryophyllinus*, *Puccinia malvacearum*, *Puccinia antirrhini*, *Puccinia graminis*, etc.

It is hoped that others may find the method of some value.

B. T. Dickson

Macdonald College,
Quebec, Canada

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION O—AGRICULTURE

The sessions of Section O, held in the Soldan High School, St. Louis, Mo., December 29 and 30th, 1919, were devoted to the discussion of the general subject: "The Relation of the Use of Power and Labor-saving Machinery to Agricultural Progress." For the sake of effective presentation, the general subject was considered in four of its important relations, namely, the influence of farm machinery on production, labor and wages; the influence of power and machinery on social and physical conditions surrounding farm life; the application of power to save labor; and future needs and developments.

In discussing the first of these topics, Mr. Arnold P. Yerkes, of the International Harvester Company, referred to the evolution of farm machinery and pointed out that the first real farm machine was invented less than half a century ago. Such farm tools and implements as were used a hundred years ago were of the one-piece variety and could not be properly designated as machines. They were very nearly identical with those that had been used by farmers for two or three thousand years. The invention of the reaper, in itself a rather simple machine, was quickly followed by other inventions represented by at least 100 distinct implements used on American farms at the present time. "During this period of invention and development of farm machines, American Agriculture has undergone a tremendous change. The old farming methods, which involved a great deal of hand labor, have given way for the most part to the use of machinery. An entirely new era of agriculture has been brought about and the new order has been made possible only through the invention of machines which reduced the amount of labor and the percentage of the population required to produce foodstuffs, thus enabling transportation and other industries to develop simultaneously with agriculture."

The invention and use of farm machinery has had at least two effects on labor. There has been a saving of labor by the increase in the efficiency of the individual and the consequent reduction in the number of men required to accomplish a given task. There has been, further, a substitution of animal and mechanical energy for human energy and the making of farm work less irksome and exhausting. For these reasons the employer of farm labor lays less stress than formerly on mere physical development and is willing to pay more for technical skill, initiative and manual expertness. "Incidentally these changes, brought about by the use of machinery, have resulted in a decided change in the type of farm hands upon American farms as whole. A few years ago immigrants who had had experience on the small farms in Europe made what were considered first-class farm hands, since they had a fair knowledge of a type of farming which did not differ materially from that found in this country. At that time many of the immigrants sought employment on farms in America and found it. But with the increased use of farm machinery this class of labor became less and less satisfactory because very few of the immigrants had any knowledge whatever of farm machinery, and, as many of them could not understand the English language, it was difficult to teach them. The practise of hiring these "green" immigrants therefore became less common."

Farm machinery, according to Mr. Yerkes, has not only increased the output per worker, but has made possible the more rapid extension of the cultivated area, and the increased production per acre thanks to the more thorough tillage of the soil and the more uniform methods of fertilization, planting and harvesting. On the whole, the use of farm machinery may be said to have increased the efficiency of man labor on American farms approximately eight times. In not a few instances the increase in man power efficiency has been even more striking. It should be remembered in this connection that the manufacture of machinery takes up a very considerable amount of labor, and that a certain allowance is to be made for it in calculating our labor resources.

"Notwithstanding the almost marvelous progress which has been made in less than a century in developing farm machinery of all kinds, there is every indication that the progress in the future seems likely to equal, if not surpass, that which has already been accomplished. It is realized that this may sound like an extravagant statement, nevertheless calm consideration of the whole subject must invariably lead one to the conclusion that this is entirely possible. Just as the invention of the reaper and its subsequent development produced a complete revolution in the methods of grain raising, so the invention and development of the internal combustion engine seems destined to work another revolution in general farming."

In his consideration of the second topic on the program Mr. F. W. Peck, of the Office of Farm Management, pointed out that farming differs from most of the other industrial pursuits in that it compels the performance of a relatively large amount of work in a limited space of time. In spite of the great range of conditions that one finds on American farms the question of labor efficiency is nearly always paramount. There is, therefore, an obvious relation of farm power to labor efficiency in American agriculture. The economic factors involved in the study of farm power relate to: (1) the requirements for power in farming; (2) the kind of power most readily available; (3) the form of power in its relation to man; (4) the influence of any given form of power on the organization and operation of the farm.

A study of the utilization of horse labor on three farms of different type showed that on a dairy farm in Wisconsin 6 horses were kept for 143 crop acres; on the Illinois corn and hog farm 9 horses were kept for 182 crop acres; and on the Iowa seed, grain and stock farm 12 horses were kept for 261 crop acres. Similar studies were conducted on large grain farms in North Dakota and Washington. In a general way it was found that on most farms hauling operations require more than half of all the horse power used; that plowing, harrowing and disking require from 15 per cent. on the small cotton and corn farm to 64 per cent. on the large Dakota grain farms. "It is safe to say that in most instances the seasonal and weather conditions limit the hours within which most operations must be performed, with the result that the work can not be expanded as might be desired."

In commenting on the same subject Mr. C. J. Galpin, of the office of Farm Management, said in his paper: "The machine is profoundly affecting the farmer's physical and mental life, as it is all human life. With every advance in machine power for the farmstead, both in the house and on the land, a shift occurs in the strain upon the farm family. Mechanical power takes more and more the brunt of gravity, and the big human muscle engine more and more falls into disuse, while the second series of finer, smaller muscle engines come more and more into play in farm work. . . . The machine-farmer becomes a new cerebral type, whose very struggle with the earth summons him to an employment of his hereditary intellectual mechanism, and a consequent intellectual life. Ever since the days of bits in the horse's mouth and reins to guide the horse, down to the present age of gas-driven tractor and motor car, the machine-farmer type has been in process of evolution. However, the hoe-farmer, both man and woman, can be found in every land, in every part of America, true to primitive type. Between these two types lies the mass of landworkers in the United States."

Under the topic "Application of Power to Save Labor" Mr. Wayne Dinsmore, secretary of the American Percheron Society, Chicago, Ill., contributed a discussion on "Animal Power"; Dean A. A. Potter, of the Kansas Agricultural College, on "Tractor Power" and Mr. Lee, of the Domestic Engineering Company, Dayton, Ohio, on "Electric Power." It was stated by Mr. Dinsmore that the mechanical motive power units in use in 1919 did not exceed 200,000. In other words, they had displaced but 2.2 per cent. of the horses and mules on the farms of the United States. According to the investigations of W. F. Handschin, of the University of Illinois, horses furnished the most economical source of farm motive power on all farms under 260 acres in area. But even on larger farms 75 per cent. of the work

could be done most economically by the use of horses. "Animal power is to-day our chief reliance in saving labor on farms, and so far as we can judge always will be. The more effective utilization of animal motive power units, and the application of labor saving methods therewith, should therefore receive especial consideration from our colleges, experiment stations and agricultural engineers."

The increasing of labor efficiency on the farm through the use of animal power involves the study of four leading factors: namely, the use of a greater number of horses per man; the application of more efficient methods in the use of animal power; the employment of more efficient types of horses; and the devising of new applications in utilizing animal power. It is worth while to note that the light two-horse teams used in New England plow scarcely more than one acre per day. In Pennsylvania and Ohio three-horse teams are often used and the acreage plowed by them will average two to two and a half per day. In Iowa and Illinois most farmers use four and five horse teams and plow four and a half to five acres per day; while in the PaLouse Country in Oregon, Washington and Idaho eight and ten horse teams are common and their performance is equivalent to eight to eight and a half acres per day. "To put the matter in another way, the men in the West were doing their work with half as much labor as Illinois' farmers and one eighth as much labor as New England farmers."

Dean Potter referred in his remarks to the part played by large scale production methods in the development of the American industries. These methods are, however, possible only where mechanical power and devices operated by mechanical power are available. In the use of horse power one man can control at most five or six power units, whereas in the use of mechanical power he can control many more units. A questionnaire sent out to Kansas farmers disclosed many interesting facts as to the cost of eparation, depreciation, efficiency of smaller and larger tractors, etc.

Considerable stress was laid by Mr. Lee on the opportunities that exist for using on the farm small electric motors of one half to three quarter horse power. Numerous tasks in the farm outbuildings and in the farm home could be performed by means of such motors, as for instance the operation of cream separators, sewing machines, pumps, vacuum cleaners, clippers, etc. Mr. Lee also referred to the need for investigation and training as bearing on the more effective use of labor-saving devices in the farm home, as well as in the outbuildings and on the land.

The last topic on the program, "Future Needs and Developments," was discussed by Mr. E. A. White, of the Holt Manufacturing Company, Peoria, Ill. Mr. White estimated that there are in use on the farms of the United States about 30 million horse power units made up of 16 million animal units, 5 million gasoline and kerosene tractor units, 4 million steam engine units and more than 3 million windmill and electric motor units. On the other hand, the manufacturing establishments of the United States control only about 18½ millions of mechanical horse power units. If nothing else, the magnitude of the agricultural industry demands the expansion in the use of animal and mechanical power where this would be warranted by economic conditions. It also demands a more intimate knowledge of the need for power, the efficient use of power and the improvement in the devices employed, as well as the training of the human agents to whom, in the last analysis, we must look for the effective use of both power and machinery.

At the business meeting Dr. E. W. Allen, chief of the Office of Experiment Stations, was nominated vice-president. The General Committee of the Association later confirmed this nomination. The other officers for the ensuing year are: Dr. A. F. Woods, retiring vice-president; Dr. A. C. True, member of council; Mr. George M. Rommel, member of general committee; Sectional Committee, Dr. C. P. Gillette (four years); Dr. John Lee Coulter (three years); Dr. A. F. Woods (two years); Dean Alfred Vivian (one year); Dr. Kenyon L. Butterfield (one year); Dr. J. G. Lipman, secretary (four years).

Jacob G. Lipman,
Secretary

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, JULY 23, 1920

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE STRUCTURE OF THE UNIVERSE[1]

THE phrase, "the structure of the universe," is apt to bring to mind only the great and majestic forms which are revealed to us by the telescope, the stars, nebulæ and galaxies. In the present discussion however I wish to include in one view the entire range of physical things from the infinitesimal to the infinite; for to the mathematician there is no such thing as absolute size—a thing is either large or small only by comparison.

Up to the present time we have succeeded in extending our vision equally, so to speak, in both directions. We find ourselves almost midway in a series of physical units. On the one side we have the electrons, atoms and molecules, and on the other we have the ordinary masses, stars and galaxies. The galaxies are more or less definite aggregations of stars. The stars are amazingly great organizations of hot gases. The gases in turn are resolved into their constituent molecules; the molecules yield up their atoms, and finally we find that the atoms are built up of two kinds of electrons. Each physical unit is analyzed into units of the next lower order, and synthesized into those of the next higher order. Each unit is an organization endowed with the proper amount of energy to carry on its existence and to insure its identity.

Our direct vision is bounded on the one side by the electrons and on the other side by the galaxies. But the common properties of energy and organization lead us naturally to imagine that the electrons in their turn are organizations of still smaller units, let us call them sub-electrons; and the sub-electrons are organizations of still smaller units, and so on, ad infinitum. Turning to the other end of the series we can fancy that there are organ-

[1] Read before the Chicago chapter of the Sigma Xi, March 11, 1920.

izations of galaxies, say super-galaxies, and still higher organizations of super-galaxies, and so on without limit. To be sure this is mere speculation and rests upon no direct physical evidence. But let us not forget that even in the days when the atom was our smallest physical unit there were many men who refused to regard it as such upon grounds which were purely metaphysical. The mere fact that the physicists have been able to take one more step down the series by conquering the extraordinary experimental difficulties, and that the astronomers in their turn are beginning to perceive in the spiral nebulæ other galaxies than our own is quite encouraging to the purely metaphysical notion that the series of physical units is an unending one, without bottom and without top.

Thus we have a conception of an infinite, three-dimensional continuum of space about which we can move at will, at least within certain limits; a conception of an infinite one-dimensional continuum of time through which we move always in one direction, without choice on our part; and finally, a conception of an infinite one-dimensional series of physical units in which our position is fixed—it is only in thought that we can move along this series. If to these we add energy and consciousness, neither of which admit the notion of dimensions, we have perhaps exhausted the catagory of fundamental conceptions.

The physicists and astronomers have nothing to do with consciousness objectly. They are interested only in the conceptions of space, time, the series of physical units, and energy. In particular, they are interested in the properties of the physical units, the nature of their wonderful organizations and the flow of energy which is associated with them. The astronomers, fortunately, are able to furnish us with photographs of the objects with which they deal, so that we are able to study them more or less thoroughly one at a time. No two of the galaxies are alike in detail although in their broad outlines there are striking similarities. The globular cluster is one type of organization of which we have some eighty specimens, and the spiral cluster is another, and of these we have some hundreds of thousands.

Descending from the galaxies to the stars we are unable to make out the structural details notwithstanding their vast size, owing to their still more vast remoteness. Only one specimen, our own sun, is sufficiently friendly to submit to anything like a close inspection. Nevertheless a classification of the stars according to their colors and their types of spectra is entirely possible. Thus the inherently brilliant white Orion-type stars have continuous spectra, save for a few broad lines of absorption due to helium and hydrogen, with a complete absence of the metallic lines. The brightest part of the spectrum is in the violet. Then come the stars of the solar type with the yellow as the brightest part of the spectrum, with many lines of hydrogen and the metals. Then the orange stars with metallic lines and absorption bands due to chemical compounds. Finally, the deep red stars with heavy absorption bands due to carbon compounds. The individualities of the stars, however, are preserved for no two of the spectra are exactly alike.

Nothing need be said with respect to ordinary masses, for they are matters of our everyday experience. No two leaves even from the same tree are exactly alike. But when we descend to the stage of the molecules the situation is very different. The physicists have not yet given us any photographs of them to study, and no one can say that he has ever seen a molecule. Their numbers are so amazingly great that an individual study of them is quite out of the question. Nevertheless, as the chemists assure us, classification is quite possible, and their variety is astonishingly great. But when we study the properties of even a single variety and attempt to work out their structural organizations we must not forget that it is only the properties common to large numbers which stand out and characterize the variety. If the human race could be studied only through the statistics of population, we might arrive at the conclusion that the Chinese are a

variety of the human race, but that one Chinaman was just like another. Analogy would lead us to doubt whether all the molecules even of water are alike. Could they be examined individually and in detail, marked differences would probably be found.

The case is similar with respect to the atoms, although the number of varieties of atoms seems to be limited while the number of varieties of molecules does not. Our information with respect to atoms is largely statistical. But even so, the chemists are recognizing the isotopes of the various elements, and certainly two varieties of lead are now known where previously we had but one; illustrating beautifully the principle that differences and individuality tend to grow with increasing acquaintance.

When we descend one more step in the scale of the physical units and reach the electrons, we are so remote from our own position in the scale and our acquaintance with these units is so far from being intimate that it is not surprising that we regard all positive electrons as being alike, and all negative electrons as being alike. We seem to have reached that ultimate simplicity for which the mind is always seeking. Nor is our information with respect to the electron entirely statistical, for Millikan has performed the amazing feat of measuring their electrical charges one at a time, and finds that in this respect they actually are measurably alike. So far then as we think of the electron as possessing the single property of the electrical charge we are justified in assuming that they are all alike. The human mind, however, is incurably speculative, and few of us, I fancy, would be willing to admit that this is their only property, or that the electrons really are all identical, or that the electron is not still further resolvable into smaller units.

Since the beginning of the present century the physicists have been very busy with the atom. The phenomena of radioactivity and of the X-rays have led them along a brilliantly lighted path in their exploration of its interior, and they have supplied us with verbal pictures of considerable clearness. The electrical charge of a positive electron is numerically equal to the electrical charge of a negative electron, but its mass is nearly two thousand times greater while its diameter is only one two-thousandths as great. If we could apply the ordinary notions of density to these statements we should have to say that the density of a positive electron is ten million million times the density of a negative electron, although its electrical charge is equal. But the ordinary notions of density perhaps do not apply.

If we accept the picture that a hydrogen atom consists of a negative electron moving in a circular orbit about a positive electron, we have so far as relative sizes and distances are concerned a veritable planetary system, except that the diameter of the satellite is two thousand times the diameter of the primary, for their distances apart are relatively as great as between the sun and Neptune. The nucleus of a helium atom has two free positive electrical charges and two negative satellites; lithium has three, and so on; there is a chemical element for each integral multiple up to 92 which belongs to the element uranium, with perhaps a half dozen gaps in the entire series; and furthermore, there is no chemical element which does not fit into the series. We have therefore a complete ordering of the chemical elements upon a purely numerical basis, which makes intelligible the periodic law of these elements which has been long known by the chemists on the basis of their chemical properties.

Notwithstanding the brilliant achievements of the physicists in their work with the atom their analysis is by no means completed. Many fascinating questions remain to be answered. For example, are all of the elements merely hydrogen atoms locked together in a very tight embrace, and if so will a sufficiently violent bombardment separate them? Rutherford's success in obtaining hydrogen from nitrogen by a bombardment with α-particles is certainly suggestive. If the answer is to be in the affirmative, what is the nature of this embrace? How do the electrons, positive and negative, arrange themselves?

How are the lines in the spectrum to be accounted for? And how does an atom radiate energy, anyway? It is a delightful situation for the mathematical physicist to face, for he has already achieved a very solid foothold, and we may be sure he will not be slow to push his advantage.

If the private affairs of the atom belong to the domain of the physicist, their social affairs belong to the chemist. And what tremendously social creatures they are! Few of them are content to live by themselves. The vast majority of them cling more or less tenaciously to other atoms or groups of atoms, and these groups are the chemists' molecules, the smallest particles of what we call ordinary matter. This grouping is not a mere random affair. The atoms exhibit a distinct choice not only as to their associates but as to the manner in which they will associate together.

Just as the physicist has his problems as to the structure of the atoms so the analytical chemist is busy breaking up the almost infinite variety of molecules he finds about him to learn what atoms enter into their structure and what are the relations which exist between those atoms. In this endeavor he has been highly successful and the great majority of molecules he can read as an open book, but the subtile strain of carbon molecules will doubtless tax his ingenuity for a long time to come. On the other hand, the synthetic chemist is slowly learning how to coax the atoms into those particular groups which either his theory tells him are possible or for which nature herself has already furnished an example. In the domain of ordinary masses the architect and engineer, the painter and sculptor and the skilled artisans of a thousand varieties have learned how to build up their structures to suit their various purposes. But the physicists have not yet dreamed of building up an electron nor an atom. The biologists have little hope of ever constructing a living organism. The geologists are content to examine their rocks and to make the past live again in their vision; while the astronomers in the very nature of things must maintain a respectful distance from the objects which engage their interest. Outside the domain of ordinary masses it is the synthetic chemist alone who can engage in the process of physical construction, the building up of those units which are the object of their study. The world is very greatly their debtor to-day, and this debt will increase enormously as the chemists rise higher and higher in their ability to control the groupings of the atoms in the molecules.

Our greatest familiarity and closest intimacy with nature naturally lies in that portion of the scale of physical units to which we ourselves belong, viz: ordinary masses. It is here that the geologists and biologists are at home. But so infinitely varied is the aspect here presented to us that these sciences divide and subdivide in their study of particular phases of things that we seem to have a whole host of sciences. To geology belong such sciences as meteorology, geography, paleontology, and mineralogy. Biology divides into the two great branches, zoology and botany, and these two branches subdivide and split up very much like the cells, about which they are so fond of talking, until one is actually lost in their numbers. Resting securely above these, at least so far as complexity of their phenomena is concerned, are the psychologists and sociologists.

Would an inhabitant of an atom, supposing him to be as small relatively as we are to the earth, find the world about him as complicated and varied as we find ours to be? Would he require a thousand and one different sciences, of which we do not even dream, in order to interpret what was going on about him and adapt things to his use as we are doing? Fortunately science does not have to answer, for there is no evidence. Science always turns away disdainfully when there is no evidence, and rightly so. It is none of her affair. But the same human being, if he is a scientist, is also a philosopher and a speculator. Perhaps he is a scientist because he is a philosopher and a speculator. At any rate, we can not but be impressed with the richness and luxuriance of our own field of units when we compare it with the poverty with which our mental pictures

endow the other fields; and so far as I am concerned, at least, I am willing to admit that this striking contrast is a fair measure of our ignorance with respect to what is going on in these other fields.

Turning our eyes upward towards the sky we see the friendly stars, for they seem friendly to one who cultivates their acquaintance. Symbols, they are, of permanence and stability for they maintain their light and their positions unchanged century after century. In order to gauge their distances we have only to imagine our sun moved far enough away that its light is reduced to that of ordinary starlight. Our imaginations are utterly impotent to grasp the ninety-three millions of miles which separate us from the sun, but this distance, great as it is, must be taken three hundred thousand times to bring us even to the nearest star; and even this prodigious distance is less than the average distance between the stars. It is hard to appreciate the vastness of astronomical space. If two unlike things can be compared, we might say that the vastness of astronomical space is comparable with the vastness of the number of atoms. Imagine, if you please, fifty millions of atoms placed side by side. Their total span would be one centimeter. Imagine then the number of atoms in a cubic centimeter of water. It is something like 3×10^{22}. Think then of the number of atoms in the ocean, or in the entire earth; or worse still, in the entire solar system. It turns out that there are something like 6×10^{56} atoms in the entire solar system. But if we give to the sun its fair share of the empty space about it, about twenty cubic parsecs, we can say that the sun's share of space is 6×10^{56} cubic centimeters; so that if all the atoms in the solar system were uniformly distributed throughout the sun's share of space there would be ten cubic centimeters of space for each atom, and relative to their respective sizes the distances between the atoms would be just about the same as the distance between the stars. Under these conditions the inhabitants of an electron would have much the same problem in determining the ordinary properties of matter that we have in determining the collective properties of the stars.

In the process of extending our conceptions of space the astronomers have been magnificently in the lead. In the extension of our conceptions of time, however, they have allowed the geologists to take the lead, although, even without any specific evidence, one would be willing to admit that astronomic time must exceed geologic time as greatly as astronomic space exceeds geologic space. As would be expected direct evidence is very hard to get, as the three hundred years since the invention of the telescope, and the two hundred years since exact observations in the modern sense of the word began, is far too short an interval for much change to have occurred. The proper motion of the great majority of the stars is less than one second of arc in a century. In a million years these motions will be less than three degrees; and motions of this magnitude occur in the field of ordinary masses in about one second. On this basis one second would correspond with a million years, and the three score years and ten of human existence would correspond to over two million billion years. In our conceptions of ordinary time we have risen to a point where a human lifetime seems short. Shall we ever attain a viewpoint where the corresponding astronomical period seems short?

Just as in the kinetic theory of gases the collisions of the molecules are the important events from a dynamical point of view, so in our galaxy of stars the close approach of two stars is dynamically an event of fundamental importance. An approach as close as the earth is to the sun would be a close approach, and for any one star such a close approach may be expected once in four million billion years, or a little more than the corresponding lifetime. The importance of these close approaches will be appreciated if it is borne in mind that it is the only method which we know by which a star could be destroyed so that its identity would be lost; for, notwithstanding the temporary stars, internal explosions scattering the remains beyond the possibility of a gravitational reassembling is unbelievable, and

a slow evaporation would eventually reduce a star to an ordinary mass. The geologists give the earth five hundred million years or more in substantially its present condition so that if it is slowly evaporating the time required for it to completely disappear would be at least of the order of magnitude which we have just been discussing. Such evidence as we have, however, indicates that the earth is growing rather than diminishing. From the viewpoint of our galaxy, a million billion (10^{15}) years would seem to be a reasonable unit of time.

Once in a very long time a star through a series of unfortunate encounters with other stars will acquire so high a velocity that it will escape from our galaxy altogether, and like the lost Pleiad, wander hopelessly through the ages in search of its sister stars; but very many of our astronomical time units will have elapsed before this process could sensibly diminish the number of stars in the galaxy. Whether or not the galaxy is already very old as some of us think, or whether it is relatively young as is thought by others, it seems to be fairly clear that in the course of time, at least, it will be very old even as measured in our very lengthy time units. As we muse upon this certainty we wonder whether the light of the stars will go out; or will they continue to shine in the remote ages to come.

In the past a very great restraint has been placed upon our vision by the gravitational hypothesis as to the source of a star's energy. According to this hypothesis the gravitational potential energy of the star is converted into the energy of heat and light and radiated away. The entire life of our sun, at its present rate of living, could not possibly exceed fifty millions of years, and there is a similar restriction upon all of the other stars. Under no reasonable assumptions as to the rate of expenditure could the period be extended to more than a few hundred millions of years. At the expiration of this period the star becomes a cold and solid body and remains such until its very existence is snuffed out in some great catastrophe. It is much the same as though a child were intellectually bright for one, or two, or perhaps five minutes near the beginning of its life, and then all the rest of its existence was spent in mental darkness; and this was true, not as an accident, but as a regular thing.

The discovery of the subatomic energies, as manifested in the radioactive processes, some twenty years ago has helped the situation somewhat, lengthening the period of a star's brilliancy two, three, five, perhaps ten times, but that is all. The dismal picture remains, notwithstanding the protests of the geologists and the biologists, and the absolute failure of the astronomers to find any evidences of these cold and solid bodies and dead galaxies, which should be vastly more numerous than the live ones. But if the results are still unsatisfactory the discovery and exploration of the subatomic world has at least relieved us of a dogmatism which could say, and once did say, "You have so much time for your evolution. and no more." It has opened our eyes to the perception of new things, and awakened our minds to new possibilities for which direct physical evidence is still wanting.

The doctrine of the conservation of energy has been a well established doctrine among all classes of scientists for seventy-five or eighty years. Notwithstanding this, we have allowed the greatest flow of energy with which we are acquainted, the prodigious energy of the stars, to escape into the blackness of space unnoticed and forgotten, quite contrary to that somewhat more hazy doctrine which we call the economy of nature. We simply did not know what to do with it. Suddenly we discover that the atoms are wonderful organizations of energy. The vastness of their numbers, comparable only with the vastness of astronomical space, suggests that their organization is an astronomical matter, for the astronomers alone can furnish energy in sufficient amount and equip a laboratory of sufficient size. That the details of this equipment are unknown need occasion no surprise, but the products of this mighty laboratory are visible upon the sky. Irregular nebulæ of gaseous materials occupying enormous volumes of space are found in abundance there, and much evidence of dark nebulosity against

luminous backgrounds. Is it too much to suppose that these nebulæ consist of atoms recently formed in the laboratory of space and beginning to assemble for their careers in the world of matter? This would seem to be the simplest guess, and it is worth considering.

The physicists are inclined to believe that the property of mass is due to the electric charges of the electrons. If now a negative electron should collide and unite with a positive electron the electric charges would disappear, and so also would the property of mass. If the speed of this collision were equal to the velocity of light, which seems probable enough from the known speeds of the electrons then the energy set free is calculable. It is found that one gram of matter passing through such an experience would liberate five billion calories of heat. The unit resulting from this collision would not possess the property of mass, but it would be an organization of some kind. If we suppose that the radiant energy of the stars as it flows through space should succeed in splitting this unit again into two electrons the property of mass would be restored, but a corresponding amount of radiant energy would have disappeared.

So far as I know the physicists have not announced a law that for every positive electron there exists a corresponding negative electron, but the electrical neutrality of matter seems to imply that it is true. If the two kinds of electrons exist as the result of the splitting of a single unit it is easy to see why it should be true, but quite a considerable puzzle otherwise.

It seems almost axiomatic that no organized physical system can endure a condition of unlimited violence without breaking down; and since the atom is such a system it seems inevitable that under suitable conditions it will collapse, and its energy of organization will be set free. The extreme conditions as to temperature and pressure which exist in the interior of a star seem to make this an ideal place for an atom to break down and give up its energy and its property of mass, if such an event is to occur anywhere. Such a process seems almost necessary if we are to account for the energies of the stars over the extended periods of time which the dimensions and forms of the galaxies seem to imply. On such a basis the sun possesses in its present mass a sufficient store of energy to last, at its present rate of radiation, five thousand millions of years. Such a period of time is short from an astronomical point of view, but as the sun travels through space at a speed of about twelve miles per second it must pick up atoms, and molecules, and an occasional solid fragment, and in this way add to its mass. Occasionally it will pass through nebulous regions and add to its mass with relative rapidity. We can suppose that on the whole the sun, and the other stars also, gather in as much energy as they radiate, and the embarrassment arising from their relatively short periods of luminosity and their reckless expenditure of energy disappears.

To an audience of astronomers much could be said in favor of accounting for the sun's heat in this manner, but such evidence would be of but little interest to those who are not astronomers. The main point of interest to them would be that under this hypothesis the geologists and biologists are freed from the restraints as to time, for the astronomers could furnish them with all of the time which they wished. There would be no fixed upper limit to the life of the sun, and the stars in general could continue to illuminate their paths through space for indefinite ages still to come. The haunting fear of a general stellar death is gone and the forbidding picture of the galaxy as a dismal, dreary graveyard of dead stars fades away from our sight; and in its stead we see an indefinite continuation of our present active, living universe with its never-ceasing ebb and flow of energy. Those wonderful organizations which we call the physical units will continue to be built up when the conditions are favorable, pass their allotted time in such activities as are suitable to their nature, and finally yielding up the energy by which they were organized, be resolved again into the elements from which they came. The individual perishes, but the race lives on.

The astronomer with his telescope, the biol-

ogist with his microscope, the physicist with his spectroscope, and the mathematician with his logic are all busily engaged in unravelling the mysteries of the structure of the universe. They do not always think of their work in this relation. Ordinarily they will tell you that their work is directed towards the answer to some specific question in a relatively circumscribed field. But eventually the mental pictures which result from this detailed work are integrated into one grand picture of the structure of the universe itself, and all that is trustworthy in this grand picture rests upon the labors of the individual workers in their various fields.

There are certain questions, however, of a very fundamental character which no amount of labor will ever answer, and to these questions we are at liberty to return such answers as happen to please us. In other words, they belong to the domain of esthetics and not to the domain of science; and yet they are so deep and fundamental that all of our scientific pictures rest upon them. For example: Is the physical universe limited in space, or is it not limited? If it is not limited, or infinite as we say, is the portion of it which we see peculiar, or is it fairly representative? Is the epoch of time in which we live a peculiar epoch, or is it a fairly representative one? Is the universe as a whole definitely changing from its present state, or is it a permanent thing, the same yesterday, to-day and forever? I might continue with other and similar questions but there is not time now. You are at liberty to choose your own answers and upon them to rest your interpretation of the universe, or your philosophy.

For myself, I wish to think of the physical universe as infinite—it jars upon my sensibilities to think of it otherwise. I am unwilling to admit that we occupy an essentially peculiar position in either space or time. As for the universe as a whole, it has always been and always will be essentially as it is to-day. It is infinite, eternal and unchangeable.

William Duncan MacMillan
The University of Chicago

THE PAN-PACIFIC SCIENTIFIC CONGRESS AND THE BISHOP MUSEUM OF HAWAII

During the month of August, 1920, a congress will be held at Honolulu to outline the scientific problems of the central and southern Pacific Ocean, and to suggest methods for their solution. Delegates from Australia, New Zealand, the United States, and possibly Japan will take part in the discussions, and will formulate a program of research for future guidance in anthropology, geography, geology, and biology. Also it is hoped to lay a foundation for a greater utilization of the economic resources of the Pacific. The delegates are to be the guests of the Bernice Pauahi Bishop Museum of Polynesian Ethnology and Natural History, situated in the city of Honolulu. It should be noted here that the idea of a wider Pacific exploration was first put forth by this museum in 1906, and that during the past thirty years the museum has been at work on the ethnology and biology of the central Pacific. Its trustees now desire to take up the wider problems of the Pacific—and they are of fundamental importance—in cooperation with other institutions of research. Yale University, as a result of a gift from Mr. Bayard Dominick of $40,000 for scientific exploration in the southern Pacific, is enabled to enter upon thorough cooperation in the plan, and Professor Herbert E. Gregory, of the Yale faculty, is now the director of the Bishop Museum and the leader of the congress. Other institutions which have expressed a desire to cooperate are the National Academy of Sciences, the National Research Council, the U. S. National Museum, the U. S. Coast and Geodetic Survey, the Carnegie Institution of Washington, Harvard University, the American Museum of Natural History, the California Academy of Sciences, and the Scripps Institution for Biological Research.

That the results already accomplished by the Bishop Museum are extensive may be gathered from the following account. Fernão de Magalhães, making his way southwest across the rough Atlantic, was the first to

pass through the Straits of Magellan, and for nearly four months subsequent to November 28, 1520, sailed over what seemed to him the quiet waters of an unknown ocean, which he accordingly named the *Mer Pacifico*. The Hawaiian Islands were, however, not discovered until 1778, by the world navigator, Captain Cook, who landed on Kauai. In the spring of 1820 a small sailing ship landed a number of New England missionaries in Hawaii, and from that time began the modernization of human culture on the eight inhabited islands of the group. Thus arose the dominancy of the United States in these islands, which were formally annexed in 1898 and constituted the territory of Hawaii in 1900.

Mr. Charles Reed Bishop, of New York, married Princess Bernice Pauahi, the great grand-daughter of the Moi of Hawaii at the time of Cook's visit. She died in 1884, leaving her estate to establish "schools for the youth of her race"; she is often referred to as the "mother of Hawaiian industrial education." In 1889 Mr. Bishop founded in her memory the Bernice Pauahi Bishop Museum, and the following year Dr. William T. Brigham was chosen as its curator, becoming director six years later. The government of the museum is in the hands of a board of seven trustees. The original museum was a small stone building, but two large additions have been made and now it is the leading storehouse of information relating to things Pacific, and more especially to the ethnology of the Polynesian people. The Hawaiian Hall opened in 1903 is unique among museums. This privately endowed institution has made good use of the capital left it, Director Brigham having twice visited the museums of the world in his endeavor to find the best methods of caring for the collections in his charge. Mr. Bishop died in 1915, in his ninetieth year, and Dr. Brigham became director emeritus in 1917. At this time the staff consisted of five curators and eight assistants.

In 1898, the Bishop Museum began the publication of two serials, the smaller Occasional Papers, of which there are now six volumes, and the quarto Memoirs, now in the seventh volume. In looking through these publications, one is impressed by the high scientific character of the studies and the splendid dress of the memoirs. The credit is all the greater, since the publications are not only written by the staff of the museum, but printed by its own presses. The results naturally bulk largest in ethnology, since this was the primary wish of Mr. Bishop. Moreover, the Hawaiian people are no longer living in their original culture, Christianity and the ways of the white man having completely changed their modes of life. The volumes by Dr. Brigham treating of the wonderful feather work done by the Hawaiians, the making of bark cloth, mat and basket weaving, the houses of the natives, their wood carvings and stone implements, are a revelation of the skill of this primitive folk. The director has also interested himself in different lines of study, as is apparent from the titles of others of his works which are of great value: "Index to the Islands of the Pacific," "The Volcanoes of Kilauea and Mauna Loa"—and some of the volcanoes of Hawaii rise to nearly 14,000 feet above sea level—and "A Journey around the World to Study Matters relating to Museums." There is no more interesting account of the world's natural history museums than this one published by Dr. Brigham in 1913.

Most interesting are the three quarto volumes on Hawaiian antiquities and folklore, gathered and written in the native language by Abraham Fornander and translated into English by Thomas G. Thrum. Another native manuscript on Hawaiian antiquities by David Malo is translated by N. B. Emerson.

A large monograph of the flowering plants of the family Lobelioideæ by Joseph F. Rock is a thorough piece of work, while Charles N. Forbes describes in the Occasional Papers many new species of indigenous plants.

The volumes also include a "Key to the Birds of the Hawaiian Group," by W. A. Bryan, and many smaller papers on birds by the same

author and by Alvin Seale. More than 300 species of Pacific marine fishes have been cast and colored from life by J. W. Thompson and described by Bryan and Seale. Of land snails in the islands there appears to be an endless variety, certainly more than 400 forms, and the Museum has them by the hundred thousand. These have been arranged and many new forms described by C. M. Cooke. The collection of marine shells have all been determined by W. H. Dall.

Clearly this is a good beginning toward the gathering of data looking to the solution of the problems of the Pacific Ocean.

Charles Schuchert

SCIENTIFIC EVENTS

COTTON RESEARCH IN LANCASHIRE

The British Cotton-growing Research Association has issued a report covering the first nine months of its work. According to an abstract in the London *Times* actual research work has as yet scarcely begun. Dr. A. W. Crossley, the director of research, was not free to leave the University of London until Easter. The council and director agree that the association's researches will achieve success in proportion to the extent to which they are organized on a cooperative basis, the workers in the several sciences directing their efforts towards the solution of a common problem. In order that the various departments should all be working at one center, a property, known as The Towers, has been acquired at East Didsbury, a Manchester suburb, and the council is about to issue a special building fund appeal for £250,000. The next step anticipated by the council is the appointment of heads of departments on the subjects of chemistry, physics, colloids, botany and technology. Dr. A. E. Oxley, of Cambridge and Sheffield Universities, has been appointed head of the physics department, and Dr. J. C. Withers, of the chemical department, St. Thomas's, London, has been appointed to direct the abstracting and indexing of scientific and technical information in the records bureau. It is stated that information is so scattered that it will be some time before a comprehensive idea can be given of the work accomplished in the past. The report adds that the chief aim will be to arrive at the principles or theory underlying the practise of the industry, leaving the application of the theory to those actively engaged in the industry. Applied research can not, however, be entirely omitted, especially in respect of such matters as may be considered beyond the resources of individual firms.

In cooperation with the Empire Cotton-growing Committee a joint committee has been appointed, with the immediate object of granting scholarships to graduate students, so as to secure a supply of trained men for the future. Three botanical research studentships have already been established. The total number of individual members of the association is 1,408. The income for the year, including £6,750 government grant, amounts to £17,150.

THE BRITISH SCIENCE GUILD

Nature reports the annual meeting of the British Science Guild held in London on June 8. Lord Sydenham, the president, in his address on "Science and the nation," discussed industrial problems, due partly to an abnormal state of mind arising from the war, but originally fostered by the industrial changes of the last century, namely, the general use of machinery, rendering labor monotonous and leaving less room for the individual skill of the craftsman, and the formation of large companies, whereby the personal touch between master and man was lost. In the latter portion of his address Lord Sydenham emphasized the importance of a more general knowledge of science, especially amongst members of the government and the Civil Service, and alluded to the efforts made by the Guild in the dissemination of scientific knowledge and methods. He concluded by quoting Goethe's saying that "there is no more dreadful sight than ignorance in action."

The president-elect, Lord Montagu, of Beaulieu, then delivered an address on "Some national aspects of transport," and afterwards occupied the chair. Lord Montagu remarked upon the growing difficulties of railways, which, although subsidized by the state, were

working with a diminishing margin of profit owing to the vast increase in cost of materials and in wages. In view of the national importance of these problems, the creation of a chair of transport at one of the leading universities would be a deserving object for private beneficence. The two institutions of Civil Engineers and Mechanical Engineers should be more frequently consulted by the government in regard to road transport, and the National Physical Laboratory had done excellent work. The problem, however, was so vast as to demand continuous research at a special establishment.

The annual report of the executive committee, summarized by Lord Bledisloe, dealt with various aspects of the work of the Guild. The second British Scientific Products Exhibition, held in 1919, was honored by a visit from both King George and Queen Mary, accompanied by Prince Henry and Princess Mary, and demonstrated the growing appreciation by British manufacturers of the value of applied science. During the present year it is hoped to arrange a conference on science and labor in association with the Labor party. A representative committee is being set up to collect full data on the utilization of science, not only in the civil services, but also in all government departments, and the Parliamentary committee, which has already intervened with good effect in the Forestry Bill, will watch all prospective legislation involving scientific and technical issues. The education committee of the Guild is still pressing for a real survey of the existing provision of university and higher technical education in the country, considering that the new standing committee on university grants, acting under the Board of Education, is inadequate as regards composition and reference. The revised specifications of the technical optics committee in regard to microscopes have already been adopted by two British firms.

THE DIVISION OF CHEMISTRY AND CHEMICAL TECHNOLOGY OF THE NATIONAL RESEARCH COUNCIL

THE annual meeting of the Division of Chemistry and Chemical Technology, National Research Council, held in Washington, on May 7, is reported in the *Journal of Industrial and Engineering Chemistry*. There were present Messrs, Alsberg, Bancroft, Bleininger, Derick, Fink, Francis, Johnston, Lamb, Moore, Noyes, Stieglitz, Washburn; and by invitation Messrs. Angell, Christian, Cottrell, Kellogg, Mendenhall, Munroe, and Yerkes.

The following officers were elected for the ensuing year: Vice-Chairman, Julius Stieglitz; Members-at-Large, A. A. Noyes, E. W. Washburn. The members of the Executive Committee will be the chairman and vice-chairman, C. L. Alsberg, A. B. Lamb, John Johnston, and W. D. Bancroft, *ex-officio*, retiring chairman. The American Chemical Society nominated C. L. Alsberg, W. D. Bancroft, and C. G. Derick as members of the division, and the American Institute of Chemical Engineers nominated H. K. Moore.

In connection with the meeting of the International Chemical Union to be held in Rome, Dr. Charles L. Parsons was appointed delegate. The admission to the Union of Poland and Czecho-Slovakia was favored, the division expressing the unanimous opinion that any neutral nation, eligible from the point of view of its scientific activities, that might apply for admission should be admitted.

In presenting the report of the Committee on Synthetic Drugs, Julius Stieglitz, chairman, pointed out the valuable work done by this committee in furnishing information and advce to manufacturers. The report of the Committee on Explosives Investigations was presented by the chairman, Professor Charles E. Munroe. The Committee on the Thermal Properties of Explosive Materials was not continued, the work being transferred to the Committee on Explosives Investigations. This latter committee was requested to associate with itself W. P. White and others interested in the study of the thermal properties of explosives. In the absence of H. N. Holmes, chairman of the committee on colloids, the report of the committee was presented by W. D. Bancroft.

Upon the suggestion of C. G. Derick, a committee on methods of organic analysis was appointed. The need for cooperation between

the various laboratories and individuals working on contact catalysis was pointed out by Chairman Bancroft, and as a result a Committee on Contact Catalysis was appointed, with W. D. Bancroft as chairman.

A report on the publication of critical tables of physical and chemical constants was presented by H. K. Moore. The council approved the suggestion that a special agent be employed to devote his entire time to the solicitation of funds for this publication. Thereupon H. E. Howe was appointed a fourth member of the board of trustees; W. D. Bancroft and C. E. Mendenhall was authorized to pay for the drawing up of a preliminary plan for the scientific organization of the tables, as a concrete basis for obtaining subscriptions.

Dr. Cottrell was appointed to draw up a resolution in support of the Patent bill, with instructions to forward the resolution to the Patent Office committee of the National Research Council for such action as it saw fit to take.

THE PERMANENT FUNDS OF THE AMERICAN ORNITHOLOGISTS' UNION

The *Auk* states that from time to time the union has established several permanent funds for special purposes. In every case the principal with such contributions as may be received is invested so as to remain intact and the interest only is used for furthering the objects of the fund. The most important of these funds are: the Brewster Memorial Fund, the Research Fund, and the Publication Fund.

The Brewster Memorial Fund, the most recent, is the gift of the friends of William Brewster to perpetuate the memory of one of the founders and former presidents of the union by establishing a fund to encourage research in American ornithology. The sum of $5,200 received in 1919, has already increased to some extent and the proceeds will be awarded biennially in the form of a medal and an honorarium to the author of the most important contribution to the ornithology of the Western Hemisphere during the two years immediately preceding. This fund is administered by a special committee and the first award will be made in 1921.

The Research Fund was established some years ago by a gift from Miss Juliette A. Owen, of St. Joseph, Mo., one of the Life Associates of the Union, to encourage original research in ornithology. It now amounts to several hundred dollars but the interest will not be available until the total amount reaches $5,000. It is highly desirable that this fund should be increased at an early date so that the proceeds may become available for promoting ornithological work. Already applications have been received for assistance in special investigations which would be greatly stimulated if small grants could be made from this or some similar fund.

The publication fund comprises receipts from life memberships, bequests and special contributions. In *The Auk* for January, 1920, the editor has called attention to the immediate need of a fund of $25,000, and in response to this appeal subscriptions of several hundred dollars in sums of $100 or less have already been received. The editor of *The Auk* says that not only is an adequate fund necessary to place the publication of the journal on a permanent basis and to issue check-lists, indexes and special bibliographies, but means should be provided also for publishing occasional memoirs, monographs and more extensive papers than have hitherto been attempted. At this time when the usual channels of publication are becoming restricted on account of the high cost of printing it is especially desirable that the American Ornithologists' Union should be in a position to meet the demands which are made upon it. As its permanent funds increase the union will be able to broaden the scope of its work and to make more substantial contributions both to the development and diffusion of knowledge of ornithology.

SCIENTIFIC NOTES AND NEWS

Dr. W. W. Campbell, director of the Lick Observatory, has been elected a foreign honorary fellow of the Royal Society of Edinburgh.

Dr. L. Hektoen, director of the John McCormick Institute for Infectious Diseases,

Chicago, has been elected a member of the Swedish Medical Society in Stockholm.

A PORTRAIT of Dr. Thomas Huston Macbride, president emeritus of the University of Iowa, was presented by C. F. Kuehnle, on behalf of the alumni to the university at the June commencement. The portrait was painted by Professor C. A. Cumming, of the department of graphic and plastic art, and is life size.

DR. ELIAS POTTER LYON, dean of the University of Minnesota Medical School, was granted the degree of doctor of laws by the St. Louis University at its recent commencement.

MORRIS SCHERAGO, formerly head of the department of bacteriology of the University of Kentucky, has been appointed assistant bacteriologist in the New York State Laboratory.

PROFESSOR J. G. GALLAN, of the department of steam and gas engineering of the University of Wisconsin, who has been on leave of absence during the present academic year, has recently resigned to become professor of mechanical engineering in Harvard University. He will teach factory administration and will also act as consulting mechanical engineer for an eastern manufacturing company.

WILLIAM D. ENNIS announces his resignation as professor of marine and mechanical engineering in the post graduate department of the United States Naval Academy, to become vice-president of the Technical Advisory Corporation of New York. Mr. Ennis has been associated with the latter corporation since its organization and will be hereafter located at its general offices, 132 Nassau St., New York City.

MR. ROBERT V. TOWNEND, chemist in charge of the chlorinated toluene products with the Semet-Solvay Co., has accepted a position with the Victor Talking Machine Co., Camden, N. J., where he will organize and direct their department of chemical research.

DR. N. E. DORSEY, who recently resigned as chief of the radium and X-ray section of the Bureau of Standards in order to take up private consulting and testing work, has been retained by the bureau in the capacity of consulting physicist.

WE learn from *Nature* that on the occasion of the birthday of the King of England the following were knighted: Professor F. W. Andrews, St. Bartholomew's Hospital; Captain D. Wilson-Barker, captain-superintendent of the trainingship *Worcester*, and past-president of the Royal Meteorological Society; Dr. J. C. Beattie, principal of the University of the Cape of Good Hope; Mr. W. B. M. Bird, founder of the Salters' Institute of Industrial Chemistry; Dr. H. H. Hayden, director of the Geological Survey of India, and Professor J. B. Henderson, professor of applied mechanics, Royal Naval College, Greenwich.

MR. O. F. BROWN, assistant inspector of wireless telegraphy in the Post Office, has been appointed technical officer to the Radio Research Board, which has been formed recently under the chairmanship of Admiral Sir Henry Jackson, in connection with the Department of Scientific and Industrial Research.

COLONEL H. G. LYONS has been appointed director and secretary to the Science Museum, South Kensington, in succession to Sir Francis Ogilvie, who has been transferred to the Department of Scientific and Industrial Research.

THE death is announced of Augusto Righi, the distinguished Italian physicist, professor in the University of Bologna.

PROFESSOR T. R. RYDBERG, of the University of Lund, elected a foreign member of the Royal Society for his researches in spectroscopy, has died at the age of sixty-five years.

A. A. INOSTRANSEFF, for many years professor of geology in the University of Petrograd, has died at the age of seventy-seven years.

DR. F. A. TARLETON, senior fellow of Trinity College, and formerly professor of natural philosophy in the University of Dublin, died on June 19.

A SURVEY of the steamer *Albatross* was made on May 25 and 26 by a board consisting of I. H. Dunlap, assistant in charge of office, Lighthouse Inspector J. T. Yates,

and Lieutenant Commander Henry B. Soule, United States Navy. A thorough examination was made and the vessel, while showing the effect of active service in which she has been engaged for the past six or eight months, was found to be in good condition and to require a relatively small amount of overhauling. Since the *Albatross* has been received back from the Navy she has been employed in investigations in the Gulf of Mexico and the Gulf of Maine.

The Civil Service announces an examination for research engineer. A vacancy at Watertown Arsenal, Watertown, Mass., at $3,000 to $3,600 a year, and vacancies in positions requiring similar qualifications may be filled from this examination. The duties of the appointee will consist of examination of research problems and the design of special apparatus in connection with experiments; submitting reports covering experiments; and, in some cases, putting the recommendations or findings into actual plant operation; also preparing reviews of scientific subjects, including translations from both French and German. The commission also announces an examination for scientific assistant, Bureau of Fisheries, to be held August 4, 1920. From this examination it is hoped to fill several vacancies in the Bureau of Fisheries at basic salaries of $1,200–$1,400 a year. Prospective candidates should apply to the commission for a copy of Form 1812.

A correspondent sends us the following letter from Professor P. Rona, of the University of Berlin.

I have recently accepted the editorship of the *Zentralblatt f. Physiology*, published by Julius Springer. This journal has been organized along the lines of the *Chemische Zentralblatt* and will take in the entire field of biology. Foreign papers, that is non-German publications, will be given particular consideration.

It would therefore be of extreme importance if I could receive, with your assistance, all the American publications, either in exchange or as reprints, and if necessary through subscription to such journals. The latter, however, would be out of the question for the present on account of the high rate of exchange. Of equal importance to us would be the reports of the various agricultural and biological stations, etc., which are not available at the ordinary publishers.

A letter has been received by the president of Columbia University, from Professor Albert Einstein, of Berlin University, thanking the trustees of the university for the Barnard Medal, conferred on him at this year's commencement on nomination of the National Academy of Sciences "in recognition of his highly original and fruitful development of the fundamental concepts of physics through application of mathematics." The letter says: "I beg to express to you my glad thanks for the great honor which you propose to do me. Quite apart from the personal satisfaction, I believe I may regard your decision as a harbinger of a better time in which a sense of international solidarity will once more unite scholars of the various countries."

Dr. Thomas P. Foley, chairman of the contract practise committee of the Chicago Medical Society, has started a movement among the members of the society to organize a union and has made the following statements:

Why should a physician, who has studied for years to perfect himself for his work, be paid less than an unskilled laborer? Yet it is the rule rather than the exception.

Recently a physician giving full time to industrial surgery in a large Chicago plant, rendered first aid to a man working as an unskilled laborer. The physician received $75 a month with room and board. The laborer's pay check for one week, which he showed the physician, was for $80.

Take the state service for example. At the Dunning Hospital for the Insane the chief electrician stands next on the pay roll to the superintendent. His salary is $265 a month. That of the highest paid physician on the staff is only $245. The electrician is a union man. The physician has no organization back of him.

We propose to form an organization along semi-union lines in Chicago like the lawyers' association and other such bodies of professional men. It is not aimed at the public, but rather at industrial and other corporation employers of physicians.

UNIVERSITY AND EDUCATIONAL NEWS

OHIO STATE UNIVERSITY has received a gift of $400,000 by Charles F. Kettering, a trustee of the university, for medical research in connection with the college of homeopathy.

W. A. CLARK, JR., of Butte, Montana, has presented a fund of $4,000 to the geological department of the University of Wisconsin for the purchase of equipment for experimental work in structural geology.

THE University of Wisconsin has obtained legal authority to offer a complete four year medical course.

DR. CHARLES B. FULTON, of Cleveland Ohio, has been appointed a director of the School of Mines and Metallurgy, Rolla, Mo.

DR. EMERY R. HAYHURST, professor of hygiene at Ohio State University, has been made head of the department of Public Health and Sanitation and Mrs. Norma Selbert, formerly of the University of Missouri, has been appointed assistant professor of public health nursing.

DR. W. THURBER FALES, of Malden, Mass., has been appointed instructor in biology and public health in the medical school of the Johns Hopkins University.

DR. V. J. HARDING, associate-professor of biological and physiological chemistry at McGill University, has been appointed professor of pathological chemistry in the University of Toronto.

DR. DOWELL YOUNG, of Cornell University, has been appointed professor of biology in Dalhousie University, Halifax, in place of Professor C. Moore, resigned.

AT the University of Leeds Dr. W. E. S. Turner has been appointed professor of glass technology, Mr. J. Husband professor of civil engineering and Dr. Mellanby professor of pharmacology.

DISCUSSION AND CORRESPONDENCE

THE RESCUED FUR SEAL INDUSTRY

AT the St. Louis fur auction held on February 2, 1920, there were sold for the United States government 9,100 skins of fur seals, the net proceeds of which were $1,182,905, an average of $140.98 per skin.

That sale marks an important period in the history of the most practical and financially responsive wild life conservation movement thus far consummated in the United States. In 1911 one of the stakes set by the advocates of the five-year close season was a return to a revenue of at least "$1,000,000 per year," and now it is no exaggeration to say that the results of the long close season that began in 1912 and ended in 1917 have been everything that the close-season advocates claimed that they would be.

The steady and very rapid increase in the fur seal population of the Pribilof Islands during their five years of immunity from commercial slaughter is revealed by the following official census figures as made by the United States Department of Commerce, and kindly furnished by Secretary Alexander.

In 1912 there were 215,738 seals of all ages.
In 1913 there were 268,305 seals of all ages.
In 1914 there were 294,687 seals of all ages.
In 1915 there were 363,872 seals of all ages.
In 1916 there were 417,281 seals of all ages.
In 1917 there were 468,692 seals of all ages.
In 1918 there were 496,432 seals of all ages.
In 1919 there were 530,237 seals of all ages.

The total number of fur seals killed for their skins since the open season began have been as follows:

In 1918 the number was 34,890.
In 1919 the number was 27,821.

The prices realized at the St. Louis fur auctions on the sale of fur seal skins are revealed by these figures:

In 1918 there were sold 8,100 skins for $375,385. Average, $46.34 per skin. In 1919 there were sold 19,157 skins for $1,501,603. Average, $78.38 per skin. In 1920 there were sold 9,100 skins for $1,282,905. Average, $140.98 per skin. If the average price of $140.98 at which the lot of 9,100 skins sold on February 2, 1920, should hold for the entire

catch of 27,821 skins taken in 1919, the total gross revenue for the lot would be $3,922,204.58.

In view of the feverishly advancing prices of all kinds of real fur, the growing scarcity of the supply, and the clamorously insistent demands, both of the rich and the poor, there are good grounds for the belief that very soon we will see good raw fur-seal skins selling at auction at an average price of $250 each. With 110,000,000 people in America demanding "fur," the future of the trade in real fur is remarkably bright—so long as the supply lasts—and Congress may regard the future of the nation's fur seal industry with entire complacency. The saving of the fur seal herds was a good investment.

In the future, when all other bearers of good fur have been utterly exterminated—*as they soon will be*—the protected fur seal herds will produce, by sure-and-certain arithmetical progression, a really vast quantity of the finest fur in the world. It needs no stretch of prophecy to foretell the annual increment to the three nations who now are so sensibly preserving the fur seals of Alaska from killing at sea. When we begin to take, as we formerly did in the days of the fur seal millions, an annual catch of 100,000 skins, the importance of the salvaged fur-seal herd will be realized. If we figure it out on a basis of the sale of February 2, 1920 at St. Louis, the answer is $14,098,000 *per year*, 75 per cent. of which will belong to the United States.

Under the terms of our treaty with England and Japan we are dividing net proceeds with those two partner nations, who now help us to preserve the fur seals when at sea, on the perfectly fair basis of 15 per cent. to Japan, and 10 per cent. to England. During the five-year closed season we annually paid to each of those two nations the sum of $10,000.

In its habits the fur seal—which in reality is not at all a true seal, but a fur-coated sea-lion—is one of the most remarkable of all sea-going mammals. There are writers who still insist that fur seals can be managed by man just as a farmer manages his herds of breeding cattle and horses. As a matter of fact, the fur seal is hopelessly wild and untamable, and the only "management" that man can bestow upon the free animal is in terms of slaughter. He can drive it and kill it by artificial or by natural selection, but that is absolutely all. The fur seal migrates, returns, breeds and feeds solely in accordance with its own erratic and persistent will, and man's so-called "management" lies solely in the use of the seal-killer's club and the skinning-knife.

William T. Hornaday

New York

SIDE-TO-SIDE VERSUS END-TO-END CONJUGATION OF CHROMOSOMES IN RELATION TO CROSSING OVER

The stonefly, *Perla immarginata* Say, is exceptionally fitted for chromosome studies as it has only five pairs (including the X-Y pair) of chromosomes, each pair of which is structurally differentiated from all others. My observation on this form made in 1917–18 forced me to the conclusion that in the prophase of the first spermatocytic division "homologous chromosomes are connected to each other telosynaptically in the spireme," and later "they bend toward each other at the synaptic point and become reunited parasynaptically before metaphase." These conclusions are in agreement with a limited number of workers but are so opposed to the general contention of the majority of cytologists to-day that it was considered then unprofitable to do anything more than describe the process as observed. This was done in my previous paper in the *Journal of Morphology*,[1] in which no attempt was made at theoretical discussion in relation to certain genetical evidences.

As so convincingly summarized in Morgan's recent book,[2] Mendel's original law—the segre-

[1] Nakahara, W., "A Study on the Chromosomes in the Spermatogenesis of the Stonefly, *Perla immarginata* Say, with Special Reference to the Question of Synapsis, *Jour. Morphol.*, Vol. 32, 1919.

[2] Morgan, T. H., "The Physical Basis of Heredity," 1920.

gation and independent assortment of factors—has been shown to have a close parallelism with the actual behavior of the chromosomes. The situation is quite otherwise, however, as to the mechanism of crossing over. Morgan is right when he states that "while the genetic evidence is favorable in all essentials to the theory of interchange between homologous chromosomes, it must be confessed that the cytological evidence is so far behind the genetic evidence that it is not yet possible to make a direct appeal to the specific mechanism of crossing over on the basis of our cytological knowledge of maturation stage." Morgan, however, assumes the side-to-side conjugation as a fact. His analysis of data on parasynapsis leads him to the conclusion that the early thin thread stage is most favorable for crossing over to take place. End-to-end conjugation, or telosynapsis, according to Morgan, "would have serious consequence for genetics . . . , for while side-to-side union offers an opportunity for interchange between the paternal and maternal members of a pair, no such interchange could be postulated if end-to-end conjugation took place."

It is the purpose of the present note to emphasize that the process of end-to-end conjugation, at least as described by Nothnagel[3] for a botanical object, and by myself[1] for a zoological one, does offer an opportunity for crossing over to take place, contrary to Morgan's statement. End-to-end conjugation simply restricts the stage in which such an opportunity is offered. This can be readily seen from the works of the above-mentioned authors, who describe essentially the following process:

A separate loop or segment of double spireme, whatever the nature of its duality may be, gradually bends and halves of the loop come to lie closely side by side. In the tetrad thus formed there are four longitudinal strands or threads.

It will be seen, then, by telosynapsis, an opportunity is offered for interchange between chromosomes at the thick thread stage, but at this stage only, in the manner originally suggested by Janssen[4] in his chiasma type theory.

It must be remembered that the condition of the chromatin threads at the early stage when the double spireme develops is extremely difficult to study minutely and accurately with the method and apparatus at our command. Under such circumstances, any inclination on the part of the observer will have a considerable influence on the interpretation. If one is so disposed, he may consider the condition of the threads as representing the process of pairing up. Dual threads develop out of reticulum at this stage, and that was all I could be sure of. There was certainly no observable evidence of the process of pairing up of two simple threads at least in the stonefly I studied.

On the contrary, the formation of a tetrad or ring by the bending of a loop of double spireme, which appear in haploid number is a clearly demonstrable fact. It is from this ground that I interpret the haploid as being composed of two homologous chromosomes jointed up end-to-end, and its duality as indicating primary splitting. No one has ever seen two chromosomes actually coming into conjugation, but the subsequent bending, reconjugation in side-to-side position, and the ultimate segregation at metaphase, of the halves of the loop is explicable only under the assumption that two chromosomes were united end-to-end in the loop.

Whether I am right in this interpretation or not will be decided by future studies—perhaps in very near future. Detailed comparison of the premeiotic stage with the prophase of somatic mitosis would throw some light on the situation. Also, a careful re-examination of forms (Orthoptera, for instance), in which parasynapsis is customarily claimed to occur, with special reference to the haploid loops in the thick thread stage would help settle the question. Possibility no doubt exists that the

[3] Nothnagel, M., "Reduction Division in the Pollen Mother Cells of *Allium tricoccum*," *Bot. Gaz.*, Vol. 61, 1916.

[4] Janssen, F. A., "La théorie de la chiasmatypie. Nouvelle interprétation des cinèses de maturation," *La Cellule*, T. 25, 1909.

process may be different in different organisms, but I consider it rather improbable in view of the fact that both para- and telosynapes have been described for different groups of plants and animals, and especially since certain "evidences" involved in the argument are not easily observable.

Summing up: contrary to the general belief, so-called end-to-end conjugation does offer an opportunity for interchange between chromosomes at the late thick thread stage in the prophase of maturation division, but at this stage only. If telosynapsis is a universal phenomenon, it would seem that crossing over must take place at the stage here specified. Of course, no morphological evidence has yet been produced for crossing over, and the most that can be said from the present cytological data is that such an interchange is not impossible at a certain stage in the muturation division.

WARO NAKAHARA

DESTRUCTION OF ZOOSPORES OF PLANT DISEASE ORGANISMS BY NATURAL ENEMIES

IN making some motion-picture photomicrographs of the liberation of zoospores from the sporangia of *Physoderma zeæ maydis* (see Tisdale, *Jr. Agr. Res.*, Vol. 16, p. 137, 1919) the author observed destruction of the zoospores by certain animalcules which are commonly found in decaying vegetable material. No reference has been found regarding the importance of these natural enemies of the plant diseases which are disseminated by zoospores.

The number of zoospores swallowed by one rotifer (*Proales* sp.) is remarkable. When the animalcules are abundant there is a speedy disappearance of the zoospores. One infusorian (*Keronia* sp.) was observed to devour a perfect stream of the zoospores of *Physoderma*, at the same time increasing in size until it became gorged almost beyond recognition.

In active cultures one may see a field in the microscope filled with millions of zoospores swimming about. In a few hours large numbers of these have been devoured by the animalcules, which rapidly increase in numbers. A few hours after this one then sees these same protoplasm constituents swimming about not as zoospores but as animalcules. The process of change is so rapid it makes one wonder if there is always cleavage of the proteins and resynthesis or whether there may not be some shorter method of assimilation especially in the unicellar organisms in which the cytoplasms of the infusorian and the zoospore ingested are in such intimate contact.

In starting from dry material collected from cornstalks infested with *Physoderma*, the animalcules appear first and are on hand for each crop of zoospores.

It would be desirable to determine just how important such animalcules are as natural enemies of those plant diseases which are disseminated by zoospores. Also we should collect data to determine if the destruction of the soil animalcules by excessive liming may not be correlated with epidemics of these diseases.

R. B. HARVEY

U. S. DEPARTMENT OF AGRICULTURE

THE JOURNAL OF MORPHOLOGY

AT its annual meeting in St. Louis, the American Society of Zoologists voted to accept the proposition made by Dr. M. J. Greenman, of the Wistar Institute, that in the future the society should assume control of the scientific policy of the *Journal of Morphology* and elect the editorial board, while the Wistar Institute retained control of the financial management of the journal.

A committee composed of M. M. Metcalf, Caswell Grave and W. E. Castle was appointed to initiate a scientific policy; to nominate an editorial board; to consult with the advisory board of the Wistar Institute and to refer its recommendations for final decision to the executive committee of the society.

This committee on publication and the executive committee and the Wistar Institute have agreed to the following action which accord-

ingly forms the basis for the cooperation between the American Society of Zoologists and the Wistar Institute regarding the *Journal of Morphology*. The full report of the committee will be published in the proceedings of the 1920 meeting of the society, but on account of the general interest the following summary is presented at this time:

I. That there be elected a managing editor of *The Journal of Morphology* to serve for a period of five years and that he be eligible for reelection at the expiration of his period of service.

II. That there be elected nine associate editors of *The Journal of Morphology;* three to serve until January 1, 1922; three to serve until January 1, 1923; and three to serve until January 1, 1924.

That beginning with the annual meeting of the society at the end of the year 1921, and annually thereafter, there be elected by the society upon nomination, by the same method as is provided for the nomination of other officers, three associate editors to serve for three years to take the places of the three retiring associate editors. That before making nomination of such associate editors, the nominating committee shall consult the board of editors of *The Journal of Morphology* and also the director of the Wistar Institute and through him the Board of Advisers of this institute.

This is suggested as a matter of courtesy to the institute, not as a matter of necessity, for the election of the editors of this journal shall lie with the society.

That a retiring associate editor shall not be eligible for reelection until after the expiration of one year subsequent to his retirement.

III. That the three incoming associate editors be constituted a consulting committee to visit the Wistar Institute at its invitation and expense, to serve as a means of cooperation between the two organizations.

IV. That the board of editors make annual report to the society upon *The Journal of Morphology* and any matters of publication that they may wish to include.

V. That the consulting committee, or any of its members, if they desire to do so, may report any year to the society any suggestions or recommendations growing out of their visit to and consultations with the Wistar Institute.

VI. That Professor C. E. McClung be elected managing editor of *The Journal of Morphology*.

VII. That associate editors be elected as follows:

1. To serve until January 1, 1922:
   Professor Gary N. Calkins.
   Professor J. S. Kingsley.
   Professor William Patton.
2. To serve until January 1, 1923:
   Professor E. G. Conklin.
   Professor M. F. Guyer.
   Professor W. M. Wheeler.
3. To serve until January 1, 1924:
   Professor C. A. Kofoid.
   Professor F. R. Lillie.
   Professor J. T. Patterson.

VIII. That matters of editorial policy and method, not covered by the present report, be left to the board of editors, subject of course to any action of the society.

It may be well to state that no fundamental changes in the character or conduct of *The Journal of Morphology* are contemplated.

W. C. ALLEE,
Secretary-Treasurer

SPECIAL ARTICLES

A SIMPLIFIED NON-ABSORBING MOUNTING FOR POROUS PORCELAIN ATMOMETERS

SINCE the introduction of porous-porcelain atmometers[1] into general use among physiologists, ecologists and agricultural experimenters, it has been realized that one of the most important details of the operation of these instruments in the open depends upon the fact that the porous, water-imbibed surface absorbs water during rains unless special precautions are adopted to prevent this. Mounted on a simple tube, as for laboratory use, these instruments always give negative readings for periods of rapid precipitation. At the end of a rainy day the reading may be considerably smaller than it should be to represent merely the summation of all incre-

1 Livingston, B. E., "The Relation of Desert Plants to Soil Moisture and to Evaporation," Carnegie Inst. Washington Publ. 50, 1906. *Idem*, "A Simple Atmometer," SCIENCE, 28: 319–320, 1908. *Idem*, "Atmometry and the Porous-cup Atmometer," *Plant World*, 18: 21–30, 51–74, 95–111, 143–149, 1915. Other references are given in these papers.

ments of water-loss by evaporation. The reading may be nil or even negative (entrance of water into the reservoir), in spite of the actual evaporation of significant amounts of water from the instrument during the periods between showers.

It is not feasible to correct for these errors of water absorption, but the difficulty has long been practically overcome by the employment of a rain-correcting, or non-absorbing, mounting for this kind of atmometer when operated in the open during rainy weather.[2] All the non-absorbing mountings thus far suggested depend upon a mercury valve that allows water to pass through the tube freely in the upward direction, but practically prevents movement downward. As soon as liquid water is deposited on the exposed porous surface the surface automatically becomes virtually impervious to water from without, and the precipitation water runs off from the instrument as though it were glazed. When the rain ceases the valve reverses and evaporation soon begins to be registered as water-loss from the reservoir. Various types of mercury-valve mounting have been described, but the Shive form has been most generally used. All these non-absorbing mountings are relatively expensive, and the least expensive one (Johnston's) involves the use of rubber and requires special care in the installing of the instrument.

A much simpler form of mounting than any hitherto sugested has recently been tested in the Laboratory of Plant Physiology of the Johns Hopkins University. The purpose of this paper is to place the new modification in the hands of those who are interested in atmometry, so as to save them the expense and troubles of the more complicated mountings.

[2] Livingston, B. E., "A Rain-correcting Atmometer for Ecological Instrumentation," *Plant World*, 13: 79–82, 1910. Harvey, E. M., "The Action of the Rain-correcting Atmometer," *Plant World*, 16: 89–93, 1913. Shive, J. W., "An Improved Non-absorbing Porous-cup Atmometer," *Plant World*, 18: 7–10, 1915. Johnston, E. S., "A Simple Non-absorbing Atmometer Mounting," *Plant World*, 21: 257–260, 1918.

The new mounting is very simple. The porous-porcelain piece is mounted in the usual way, by means of a rubber stopper, on the upper end of a glass tube of suitable length and having a bore of about 6 or 7 mm. This tube bears a second rubber (or cork) stopper somewhat below the first, which fits the mouth of the reservoir bottle and closes it completely as far as entrance of rain-water is concerned. The reservoir stopper is not slotted to allow air entrance to the reservoir, but access of air to the interior is allowed through a short, inverted-U-shaped glass tube, one arm of which is longer and penetrates just through the reservoir stopper from without, while the other arm is shorter, is directed downward and terminates a few millimeters above the upper surface of the stopper. This U-tube may be very small and its end may be loosely plugged with glass wool to exclude insects, etc. A water-proof apron over the top of the reservoir may be employed (Livingston, 1908), or other devices to allow air entrance and to exclude rain water may be used.

Thus far we have an *absorbing* mounting, suitable only for indoor operation or for periods without precipitation. But a very simple and efficient mercury valve is inserted in the upper end of the straight tube, as follows. A tightly rolled plug of glass wool (about 1 cm. long) is inserted in the upper end of the tube, the outer end of the plug is cut off so as to have a flat surface, and it is pushed into the tube until its upper end is about 2 cm. from the top of the tube. Next, a small amount of mercury is placed in the tube above the plug (the mercury column being 5–8 mm. high) and another plug of like nature is inserted above the mercury. The mercury is imprisoned between the two plugs and can not escape, in whatever position the tube is placed.

To install the instrument, the tube is inverted and the end bearing the valve is inserted in distilled water while suction is applied at the other end. Water enters freely through the valve and the tube is nearly filled in this way. Then the porous-porcelain

piece (cylinder, sphere or Bellani plate) is filled with distilled water and the tube is set into the porcelain piece, with the rubber stopper pressed firmly into the neck. The tube is next completely filled with distilled water, by pouring from the reservoir bottle (previously filled), and then it and the porcelain piece together are quickly inverted and the free end of the tube is inserted into the reservoir in the usual manner, the second stopper closing the reservoir.

With the arrangement here described water does not pass downward through the valve, but it readily passes upward, keeping the evaporating surface supplied. This mounting appears to operate perfectly, just as well as do the more complicated forms, it is more easily installed than they, it is easily constructed and the materials are inexpensive and readily obtainable.

BURTON E. LIVINGSTON,
FRANK THONE
THE JOHNS HOPKINS UNIVERSITY

THE IOWA ACADEMY OF SCIENCE

THE thirty-fourth annual session of the Iowa Academy of Science was held in Physics Hall of the State University at Iowa City on April 23 and 24. At the opening session on Friday afternoon, the twenty-third, the memorial portrait of the late Dr. Samuel Calvin, formerly head of the department of geology at the state university and state geologist, was unveiled and presented by the Academy to the State Historical Department at Des Moines. President Stephens then delivered his address on "The Taxonomic Unit."

After the reading of papers the academy adjourned to see the moving pictures showing the University Barbados-Antigua Expedition of 1918 and also those showing the development of the potato disease known as "Leak" by the fungus *Pythium DeBaryanum*. Owing to the fulness of the program it was necessary to hold a short session after the group dinners, following which President Jessup, of the university, and Mrs. Jessup received the visiting members at their home.

Section meetings were held on Saturday forenoon and at the succeeding business session the following officers were chosen for the coming year: *President*, Nicholas Knight, Cornell College, Mount Vernon; *First Vice-president*, D. W. Morehouse, Drake University, Des Moines; *Second Vice-president*, R. B. Wylie, State University, Iowa City; *Secretary*, James H. Lees, Iowa Geological Survey, Des Moines; *Treasurer*, A. O. Thomas, State University, Iowa City.

The academy ratified the action of its executive committee in accepting affiliation with the American Association for the Advancement of Science, which action had been taken soon after the meeting of the association in St. Louis. The constitution was amended to provide for the collection of dues of the association by the treasurer of the academy at the same time as the academy dues, and also to provide for the beginning of the fiscal year on October 1. Also an amendment was passed providing for the selection by the academy of a representative on the council of the American Association for the Advancement of Science.

The Iowa sections of the American Chemical Society and the Mathematical Association of America held their meetings in conjunction with the academy.

TITLES OF PAPERS

Botany

The treatment of certain seed-carried diseases: GUY WEST WILSON.

This paper deals with work on cotton diseases conducted by the author and associates at the South Carolina Experiment Station. Cotton anthracnose is the most important disease of field crops in the southeastern states, comparing favorably with the wheat rust in the Mississippi valley. The author and his associates have perfected a method of treating the seed which is practicable on a commercial scale and which bids fair to be of considerable value in the treatment of seed carried diseases of other crops.

Some noteworthy uredinales and ustilaginales: GUY WEST WILSON.

Notes on apogamous Liguliforæ: RAYMOND A. FRENCH.

Some aspects of the plant ecology of certain Kansas sand hills: FRED W. EMERSON.

The sand hills studied lie in south-central Kansas along Arkansas river between Wichita and Hutchinson. Dense vegetation holds the sand stable wherever man permits; burning, close grazing and attempts to plant farm crops have removed natural vegetation from considerable areas not only making them useless but threatening neighboring farm lands with being covered with

blowing sand. All degrees of reclamation by invading vegetation are found. The types and characteristics of the plants are noted and short lists of the more important plants found at the various stages are given.

Notes on some Rocky Mountain plants, chiefly of the Arapahoe mountains: L. H. Pammel and R. I. Cratty.

Further notes on the germination of some trees and shrubs and their juvenile forms: L. H. Pammel and Charlotte M. King.

On the occurrence of the giant puff ball: Harry M. Kelly.

The disintegration of certain intracellular bodies: Clifford H. Farr.

The teaching of plant pathology: W. H. Davis.

Plant tumors: Henry Albert.

The vegetation of Cape Blanco: Morton E. Peck.

The major vegetation of Lake Okoboji: Robert B. Wylie.

Some Alaska fungi: J. P. Anderson.

The genus Ceanothus in Iowa: B. Shimek.

Quercus lyrata Walter in Iowa: B. Shimek.

Seasonal variations in their relation to ecological field observations: B. Shimek.

Notes on the distribution of midsummer bee plants in the Mississippi zone of Clayton county: Ada Hayden.

The growth of foliage leaves: Beryl Taylor.

Comparison of the absorption occurring in corn stalk tissue and in prepared biocolloids: L. E. Yocum and A. L. Bakke.

Mechanical preparation of sweet corn pericarp: R. A. Rudnick and A. L. Bakke.

The Orchidaceæ of Nebraska: T. J. Fitzpatrick.

The influence of forest areas in non-forest regions upon evaporation, soil moisture and movement of ground water: I. Bode.

The paper includes the results of a series of studies carried on in the northeastern part of Iowa during the summer of 1919. The work covers a comparison of the evaporation and soil moisture conditions obtaining on forested and non-forested sites, and the influence that forested areas have as to the checking of runoff, the absorption of moisture in the soil and the response of various soils at various depths to precipitation. The results and conclusions bring out some very interesting facts relative to the economic values of forest areas of a state like Iowa in conserving soil moisture, checking evaporation and regulating the flow of smaller streams throughout the state.

Chemistry

Simplified electrotitration and its use in determining the iodine ion: W. S. Hendrixson.

An examination of rain and snow precipitations: J. E. Trieschmann and Nicholas Knight.

The precipitations covering a period of 8½ months, from October 1, 1918, to June 15, 1919, were examined. The samples were collected in granite pans 20 inches in diameter, on an open spot near the center of the village of Mount Vernon, Iowa. The nitrogen in the free and albuminoid ammonia, nitrates and nitrites was determined. Most of the winter precipitations contained sulphates, probably resulting from the combustion of coal. A few analyses showed a trace of phosphate. All the rain and snow contains a constant amount of chlorine, probably carried in the winds from the Atlantic.

An apparatus for determining solubilities up to the critical temperature: P. A. Bond.

The nitration of halogenated phenols: L. Charles Raiford.

Vacuum tube circuits as a source of power for conductivity measurements: H. A. Geauque.

The free energy of dilution and the activity of the ions of sodium bromide: J. N. Pearce and H. B. Hart

Geology

Iowa terranes compared with those of adjoining states: Charles Keyes.

Since geologic phenomena are not restricted by political boundaries many of the missing leaves of Iowa's earth-history are found clearly imprinted in contiguous states. But it is difficult to make very close comparisons because of the diverse conditions and the varied aims under which the terranal schemes are constructed. By reducing to a standard the geological sections of our state and those of surrounding states a classificatory plan is effected which, although perfectly elastic, permits exact stratigraphic parallelism to be instituted.

Belated survival of Wernerian nomenclature: Charles Keyes.

Galena as denominating a notable Ordovicic dolomite is not a geographic name, as is so often supposed. James Hall, who proposed the term, derived it directly from the chief mineral content of the formation. In using the title this author manifestly modified Featherstonough's earlier name

"Galeniferous Limestone," which in turn was an alteration of Schoolcraft's usage of "Metalliferous Limestone."

Rectification of Iowa's Cambric section: CHARLES KEYES.

Recent critical inspection of the type localities of the Cambric formations of the upper Mississippi basin indicates that there are grave misinterpretations of stratigraphic succession. Thus, some well-known formational titles become synonyms and pass out of use; several names are new; and a number of substitutions appear. Exact parallelism of the upper Mississippi Basin section and that of the Ozarks is thus satisfactorily permitted.

The use of the terms flint and chert: W. S. GLOCK.

Common usage of these terms may leave such an uncertainty that a word dare not be employed where scientific accuracy is desired. For example, it is a common habit to call any form of quartz interbedded with iron ore "chert" for want of knowledge of the nature of the quartz and of the meaning of the term employed. Detailed reference to the standard English and American textbooks on geology and mineralogy substantiates the confusion which exists and which is presented therein for the instruction of the reader. Neither chert nor flint should be a provoking "catch-all"; fundamentally they are good terms whose use is justified only where exactness is implied.

The fauna of the Independence Shale: A. O. THOMAS.

This interesting fauna, first reported by Dr. Calvin over forty years ago from a very limited exposure, has recently become better known due to the discovery of several fossiliferous outcrops of the shale as reported before the academy a year ago. Among the additions to the fauna is a species of the crinoid *Arthracantha*, hitherto known only from the Devonian of the region of Lake Ontario. There is also a species of *Spirifer* akin to *S. disjunctus*, a new *Chonetes*, and a fine specimen of *Hypothyridina cuboides*. A few of the species of the Independence shale recur in the Lime Creek shale at the top of the Iowa Devonian but none of the forms just mentioned are known to occur in the later formation.

Nortonechinus, a Devonian sea urchin: A. O. THOMAS.

This is a highly specialized genus known only from dissociated plates, spines, and parts of the lantern. The test of the living animal was doubtless very flexible and was well protected by the covering afforded by the broadly expanded distal ends of the spines as in modern *Colobocentrotus*. Two other genera of echinoids also found in the Lime Creek shales will be briefly discussed.

The corals of the Hopkinton stage, Iowa Silurian: A. O. THOMAS AND BERYL TAYLOR.

The Iowa Silurian affords a rich and interesting assemblage of corals most of which are highly silicified. The Calvin Collections from the typical localities together with those made by various field classes and by the writers, furnish a large series in which some of the genera are very well represented. *Strombodes*, for example, has no less than ten species, *Favosites*, seven, *Zaphrentis*, six, and *Heliolites*, four. The reefs furnish upwards of seventy species, many of which are new.

The conservation of underground water: JAMES H. LEES.

The paper discusses the importance of water, its source and distribution, its relation to the rock strata and its use by plants. The need for better conservation is emphasized and the effect of population increase and of agriculture is discussed.

Certain post-Pliocene deposits in Missouri: B. SHIMEK.

On the occurrence of charcoal in an interglacial peat bed in Union county: RALPH W. CHANEY.

A sink hole in northeast Iowa: E. J. CABLE.

A note on the progress of investigation of the Iowan-Wisconsin border: E. J. CABLE.

A field of eskers in Iowa: JOHN E. SMITH.

The content of agricultural geology: JOHN E. SMITH.

The Palisades of the Cedar: WM. H. NORTON.

A comparison of the Nebraskan drift with the Kansan drift: GEORGE F. KAY.

Physics

The Hall effect and the specific resistance of thin silver films: G. R. WAIT.

The dependence of the resistance of silver films upon the method of deposition: G. R. WAIT.

On the dynamics of an airplane loop: L. P. SIEG.

A new high frequency tone generator: C. W. HEWLETT.

The perception of binaural phase difference not caused by an intensity effect: G. W. STEWART.

The frequency limits of the binaural phase difference and intensity effects: G. W. STEWART.

Note on the principle of similitude: I. MAIZLISH.

A table of the total number of stroboscopic velocity curves for any of the natural numbers from 1 to 500 inclusive taken as a limiting value of n and m: L. E. Dodd.

On finding the equation of the characteristic blackening curve of a photographic plate: P. S. Helmick.

The overtones of air columns: L. B. Spinney.

The stereoscope in teaching physics and geometry: LeRoy D. Weld.

The stereoscope has usually been considered a mere toy. In this paper, however, is given a method whereby stereoscopic drawings of any simple figure in space can be easily prepared and duplicated for use in the study of any subject requiring three-dimensional figures, such as solid geometry, crystal structure, analytic mechanics, optics, etc.

Psychology

Symposium: Some Results of Current Research in the Psychological Laboratory of the State University. Introduced by C. E. Seashore.

The talent survey in our music school: Esther Allen Gaw.

The Iowa pitch range audiometer: C. C. Bunch.

The normal curve of acuity in hearing: Paul B. Anderson.

The localization of sound by wave phase in the open ear: Henry M. Halverson.

What constitutes voice: Carl I. Erickson.

The application of the Mendelian law to talent in music: Hazel M. Stanton.

The personal equation in motor capacities: Martin L. Reymert.

Serial action as a basic measure of motor capacities: C. F. Hansen.

The measurement of motility in children: Lillian Tow.

The selection of talent for stenography and typing: B. W. Robinson.

A measure of capacity for acquiring skill in coordination of eye and hand: Wilhelmine Koerth.

A standardized measure of motility: Merrill J. Ream.

Zoology

Some Iowa records of Lepidoptera: A. W. Lindsey.

A biological reconnaisance of Okefinokee swamp, Georgia. The fishes: E. L. Palmer and A. H. Wright.

The Okefinokee swamp in its fish fauna is decidedly fluviatile. Like that of Florida its fish fauna may be held to have "originated from the north and is thus not tropical." The swamp has twenty-three less fresh water species than the whole state of Florida and in number of forms is not comparable to the better known Everglades of Florida. Twenty-eight species are known from the swamp and twenty-two of these are included in the collection upon which this paper is based. Sixty-three specimens of the rare *Lucania ommata* (Jordan) were taken. The southern limit of the range of *Umbra limi* (Kirtland) is increased from North Carolina to southern Georgia. In addition the material supports contentions that *Umbra pygmæa* DeKay is a synonym of *Umbra limi* (Kirtland); *Esox vermiculatus* Le Sueur, of *Esox americanus* (Gmelin.); *Enneacanthus gloriosus* (Holbrook), of *Enneacanthus obesus* Baird; and *Copelandellus quiescens* (Jordan), of *Boleichthys fusiformis* Girard.

Bird records of the season 1919–1920 in the vicinity of Iowa City: Dayton Stoner.

Cladocera of the Okoboji and Spirit Lake regions: Frank A. Stromsten.

Copepoda of the Okoboji region: Frank A. Stromsten.

Rotatoria of the Okoboji region: Dwight C. Ensign.

Similarities between the lateral-line systems of elasmobranchs and amphibians: H. W. Norris.

Naked neuromasts in amphibians correspond to pit-organs and canal-organs in the elasmobranch fishes. The mandibular series of neuromasts of amphibians is distinctly double, oral, and gular. Similarly in elasmobranchs the mandibular and hyomandibular canal organs correspond to the oral series and a mandibular row of pit-organs to the gular series of neuromasts of amphibians. The vaguely defined occipital group of neuromasts of amphibians corresponds to the sense-organ of the supratemporal canal. Three lines of neuromasts occur on the trunk of the body in amphibians, innervated by three distinct nerve rami. Three series of lateral-line organs are to be found on the trunk in elasmobranchs.

Susceptible and resistant phases of the dividing sea-urchin egg when subjected to various concentrations of lipoid-soluble substances, especially the higher alcohols: Francis Marsh Baldwin.

When subjected to suitable concentrations of various lipoid-soluble substances the developing sea-urchin egg shows unmistakable rhythms of sus-

ceptible and resistant phases, which fact constitutes additional evidence that a very intimate relation exists between the general physiological condition of the egg, and the physical state of its plasma-membrane. During the first ten to fifteen minutes after fertilization the eggs are more susceptible to all substances tried than at any other time until the period just preceding and during the division process. A period of marked increased susceptibility occurs during the division process which outlasts the furrow formation in most cases about ten to fifteen minutes, and during this interval, marked cytological effects in the eggs are noted. The best records were obtained using i-amyl and capryl alcohols, possibly indicating a higher specific toxicity of these men when compared to the others.

Notes on the branches of the aorta (Arcus aortæ) and the subclavian artery of the rabbit: FRANCIS MARSH BALDWIN.

Although the usual number of blood vessels arising from the arch of the aorta in the rabbit is two —a so-called innominate or brachio-cephalic artery and a left subclavian artery—the variations from this condition indicate the possibility of a considerable departure. In a number of cases, three vessels have their origin on the arch and in these the order is the brachio-cephalic, the left common carotid and the left subclavian arteries. Conspicuous differences in the order and sequence of the vessels from the subclavian arteries of the two sides are noted. On the left side the vessels in a number of cases show a tendency to group themselves either proximally or distally in the form of a sort of corona.

A study of the phylogeny of certain hymenopterous parasites of leafhoppers: F. A. FENTION.

This paper deals with the *Anteoninæ* (*Dryinidæ*), a small parasitic group now classed with the *Bethylidæ* under the *Proctotrupoidea*. We are now able to trace the evolution of the peculiarly specialized species from the more simple and generalized types. So far as our present knowledge is concerned these insects are parasitic on the leaf- and tree-hoppers and there is an interesting relationship in the evolution of these parasites with their homopterous hosts. The larvæ are mostly externally attached to the host and are incased and protected in the larval exuviæ which form a protective sac. The fore tarsi of the adult parasites in a great many cases are modified into perfect chelæ or clasping organs, a fact not found in any other insect group.

The relative position of the maxima contractions of the Amphibian muscle when subjected to various ranges in temperature: RALPH L. PARKER.

The results of a series of twenty experiments upon the gastrocnemius muscles of frogs showed three apparent maxima contractions within the range of plus ten degrees Centigrade through zero degrees to rigor caloris. These varied to some extent as to what degree the maxima fell, depending upon the individual. Rigor caloris of the muscles generally proximated that of the greatest maxima, while that when all were combined and averaged was less than the greatest maxima. Selecting those which recorded in all ranges of temperature and averaging them (seven) the results were nearly parallel to the average of all the muscles and only two maxima contractions appeared. Rigor caloris was greater than the maximum contraction.

A revision of the Cercopidæ of North America north of Mexico: E. D. BALL.

The family Cercopidæ is the smallest and best known of all the groups of the Homoptera. The writer's key to the genera and species of the family published over twenty years ago is now out of date. A number of changes in synonymy and distribution have been made and several species and varieties added and the whole information brought up to date.

A review of the desert leafhoppers of the Orgerini (Rhynchota fulgoridæ): E. D. BALL AND ALBERT HARTZELL.

These desert leafhoppers are a group of round, fat, short-winged insects with very peculiar structural modifications probably developed to adapt them to the extremely hot conditions of the deserts. These modifications consist in an elongation of the rostrum or beak and a lengthening of the legs so that the insect walks upright and its body is thus removed from close contact with the hot sands.

These insects are all inhabitants of the arid regions west of the Rockies and are little known. A number of new genera and species are proposed, together with the classification and life histories of the group.

Notes on some dipterous parasites of leafhoppers: I. L. RESSLER.

Two new species of Pipunculidæ, of the genus *Pipunculus*, reared from the nymph of the leafhopper *Deltocephalus sayi* Fitch are described and discussed in this paper. The Pipunculidæ are small flies about one eighth of an inch long, the head being larger than the thorax, and consisting chiefly of the large, closely approximated eyes.

While it is known that the larvæ of these flies are parasitic in their habits, very little is known of their host relations.

An intensive ornithological survey of a typical square mile of cultivated prairie: ARTHUR R. ABEL.

Bird records of the past two winters, 1918–1920, in the upper Missouri valley: T. C. STEPHENS.

A study of sociality in the phylum Coelenterata: H. J. WEHMAN AND GERTRUDE VAN WAGENEN.

On the parasites of the unios of the Lake Okoboji region: HARRY M. KELLY.

The 1919 outbreak of armyworms and variegated cutworms in Iowa: H. E. JAQUES.

The pathology of lethargic encephalitis: HENRIETTA CALHOUN.

Descriptive notes concerning the American bald eagle: BEN HUR WILSON.

Some impressions obtained from a review of Professor Nutting's narrative of the Barbados-Antigua expedition: A. C. TROWBRIDGE.

Archeology

The material for a study of Iowa archeology: CHARLES REUBEN KEYES.

The Keokuk type of stone ax: CHARLES REUBEN KEYES.

General

The comparative stability of colors in wallpaper: J. M. LINDLY.

Iowa Section Mathematical Association of America

Note on a generalization of a theorem of Baire: E. W. CHITTENDEN.

A celebrated theorem of Baire states that the necessary and sufficient condition that a function $F(x)$ defined on a closed set P in space of n-dimensions be the limit of a sequence of continuous functions defined on P is that if Q be a perfect subset of P, then $F(x)$ has a point of continuity in every portion, however small, of the set Q. Professor Chittenden calls attention to the fact that a proof of this theorem given by Vallée-Poussin can be extended without difficulty to the case of a set P in an abstract space of a type studied by Fréchet. As a special instance, P may be a perfect set in a compact space of infinitely many dimensions.

Notes on the history of indeterminate equations: R. B. McCLENON.

Professor McClenon traces the history of some indeterminate equations found in the writings of Leonardo of Pisa, showing the contributions that had been made to their solution by the Hindus and Arabs, as well as their further development by later writers, down to modern times.

A pseudo velocity-resistance graph for low angle firing: M. E. GRABER.

Mayevski's law for air resistance is unsatisfactory because the discontinuities introduced render numerical integration difficult. Professor Graber presents a smooth curve law for the velocity-resistance relation between the velocities of 750 ft./sec. and 1700 ft./sec. and compares it with a pseudo velocity-resistance standardization curve.

What is number? C. W. WESTER.

An attempt to state in a simple way some of the outstanding differences between current definitions of number, especially between what may be called the mathematical and the metaphysical definitions; and to suggest the lines along which a working agreement may be reached as to what shall be thought of as number in elementary mathematics.

The teaching of limits in the high school: J. V. McKELVEY.

In this paper Professor McKelvey discusses certain popular misconceptions in regard to limits and outlines a point of view from which a rigorous and usable understanding of this seemingly bewildering subject may be obtained. No plea is made either for or against the teaching of limits in preparatory schools.

The taxonomy of algebraic surfaces: R. P. BAKER.

The integration of the indefinite integral in the first course: W. H. WILSON.

A problem in summation of series: JOHN F. REILLY.

A geometric construction for the regular 17-gon: LINN SMITH.

JAMES H. LEES,
Secretary

DES MOINES, IA.

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.
NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, JULY 30, 1920

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

SOME OBLIGATIONS AND OPPORTUNITIES OF SCIENTISTS IN THE UPBUILDING OF PEACE[1]

WE have been free from the turmoil of actual warfare for something over a year and it is high time we turn our faces with resolute courage toward the coming years with the determination that the world shall be a happier, saner, and safer one for humanity. The results of victory have probably not been all that we expected and certainly not all that many of us desired while in many respects the results have been entirely unforeseen. To scientists, I imagine, one of the most surprising outcomes of the war has been the sudden and I believe permanent enthronement of science in the activities of humanity. In the carrying on and the winning of the war, men of science played an unexpectedly important and indispensable part. The roll of honor among the sciences is large and includes certainly all of them represented here to-night. The men in these sciences were called from every quarter of the nation; and the promptness with which they answered the calls and the effectiveness with which they met the demands made upon them should be a source of pride and profound satisfaction to every one of us.

THE STANDING OF SCIENCE IN THE MINDS OF THE PEOPLE

As a result of their work the value of research and investigation to the welfare of the nation, whether in peace or in war, has taken hold on the minds of the people as never before; and the worth and usefulness of the scientist to humanity have received general recognition from the public to an extent long justified but hardly expected in our day and

[1] An address delivered at the installation of the new members of the Alpha Chapter of Sigma Xi at Cornell University, May 18, 1920.

age. As one clear evidence of this I cite the adoption, by the American Federation of Labor at Atlantic City, of that noteworthy resolution with its remarkable preambles concerning the importance to the nation of scientific research. The resolution is well worth repeating here and is as follows:

Resolved, by the American Federation of Labor in convention assembled, that a broad program of scientific and technical research is of major importance to the national welfare and should be fostered in every way by the federal government, and that the activities of the government itself in such research should be adequately and generously supported in order that the work may be greatly strengthened and extended; and the secretary of this federation is instructed to transmit copies of this resolution to the President of the United States, to the president pro tempore of the Senate, and to the speaker of the House of Representatives.

The five preambles preceding the resolution set forth in a very clear, cogent manner the importance of research to the development of our industries, manufacturing, agriculture, mining, to increased production, and to the general welfare of the workers. One can not fail to realize that the accumulated achievements of science prior to the war together with the accomplishments of scientists during that terrible struggle have created a heritage for future generations of research workers from which they may "take increased devotion" to their chosen pursuit. Although we may feel gratified with this background of the status of research and with the present position of science we must not forget that there is another and serious side to this situation. We must not forget that this world confidence in our work and reliance upon us for future accomplishment put upon us an enormous responsibility and a high obligation to show ourselves worthy of the faith and equal to the expectations of humanity. Moreover, we are now in a position where we must make a determined effort to meet these added obligations and live up to them in the same devoted, courageous, unselfish spirit of achievement with which this heritage has come to us and we must carry them on with energy, effectiveness, and joy. What, then, are some of the obligations and opportunities of the scientist in the coming years of peace?

OPPORTUNITIES OF SCIENTISTS IN THE SOCIAL WELFARE OF THE PEOPLE

First of all it seems to me that the student of science will necessarily take a more active part in certain directions, at least, in attempts to aid in solving some of the social and perhaps political problems of the people. Indeed it appears to be his duty to do so and the opportunity is worthy of the man. As a case in point with which I have been much impressed was the partitioning of Austria-Hungary by the Conference of Paris. Simonds points out very forcefully that in this partitioning there was created one state rich in minerals and possessing considerable industrial machinery but having no areas of soil on which food can be grown for the support of its people. Another state was created containing the city of Vienna which apparently has no sources of food, of raw materials, or of any of the elements necessary for self-maintenance, while a third state was set apart that has no minerals and few raw materials but can produce more food than is needed for its own consumption yet it was given no outlet to the sea and was left with no means of transportation by which products can be exchanged between it and adjacent states. Thus the economic situation created by academic statesmen and politicians is an impossible one. If the technically trained civil-engineer, mining engineer, geologist, soil technologist, and agronomist, for example, had been sent to study the regions and their data had been laid before the Conference and the vital bearing of their findings on the economics of the situation had been pointed out, perhaps, as Simonds says, from another point of view, the eggs would not now have to be wholly unscrambled in order to make living conditions for those middle European people possible. Certainly the opportunity for the scientist in this political matter was and is

yet, I believe, perfectly evident and the world should be made to understand it.

Another field in which the scientist must take a more active part in certain social problems of the people is the direct outcome of a state of affairs which his own efforts have produced. I refer to the results of research in the industrial world and the effect on the social condition of the worker.

The researches of science in the industrial world and the enormous development of specialized machinery and processes of manufacture have resulted in producing great inequalities in the social life of the people. These researches have certainly resulted in giving power to a few men and in belittling the position and character of many men, notably, the individual workers. The technical results of industrial research have made possible the practical control of the world's production of clothing, furniture, much of its food, and means of transportation by a comparatively few men. Industrial research and development have made some men very rich and caused a great many men to remain uncomfortably poor. I do not mean to say that the laborer is not better off to-day in houses, supplies of food, clothing, entertainment, and the general comforts of life than he has ever been in the history of the world, but I do say that he is tending to become more of an automaton, more of a machine, and less of an individual and that he is still living largely under sanitary and health conditions that are wholly incompatible with the advancement of the age and our present knowledge. These effects on the worker and on society are some of the paradoxes of industrial scientific research and investigation. And it appears as though further activities of this line of research will tend still farther in the same direction, yet the need for similar and more intense investigation, as I shall try to point out, is absolutely imperative and more pressing than ever before.

Unquestionably the major problems of social welfare must be left to the student of humanities who is especially equipped by his knowledge of the philosophies, religions, languages, racial temperaments, and histories of man, to deal with these questions. Yet I believe the scientist may do much to alleviate the effects of his industrial researches and, it seems to me, he has an obligation in this matter to meet and a duty to perform which perhaps have not been fully realized. The laboring men, in one of the preambles to the resolution which I have read, have already indicated the direction in which a part of the effort of the scientist must go in this matter. In speaking of the importance of scientific research the laboring men said "and the health and well-being not only of the workers but of the whole population as well are dependent upon advances in medicine and sanitation." In this direction, then, may lie some of the efforts of the scientist to ameliorate the unsatisfactory conditions brought about by industrial research. Certainly any improvement in the sanitary and health conditions of the laboring man will react upon his social welfare. Here the medical man, the sanitary engineer, and the biologist may find an enlarged opportunity and a chance to aid in undoing, as it were, some of the undesirable results that the scientist has unwittingly brought about in his zealous investigations. Indeed, in a wider way, anything that the scientist can do to vary the monotony of the laborer's job, to remove the danger of accident to life and limb, to relieve the abnormal strain of fatigue, or to improve the man's well-being in any way should be done and unquestionably the scientist has a duty in this direction to perform.

SOME PROBLEMS AWAITING SOLUTION BY SCIENTISTS

But aside from these questions which many of us will deem relatively unimportant there yet remain out of the many momentous problems facing the world to-day at least three which are pressing for immediate solution and a fourth one which needs new emphasis and added stress.

The problems to which I refer are: (1) the serious need for an increase in the production of the necessities of life; (2) the development

in the shortest possible time of more extensive and more efficient means of transportation; (3) the increase of the sources of physical power and force; and (4) the maintenance and increase of the ideals and the spiritual forces of humanity.

In considering the first three of these problems one can not escape the conclusion that the scientist should and inevitably will be one of the chief agents upon whom the world must rely for aid in the solution of them.

THE PROBLEM OF INCREASING PRODUCTION

The world to-day is facing a serious shortage of food supplies, which, in some European countries, has already reached the acute stage of famine conditions. In the United States the farmers are facing a labor shortage which in many cases is actually curtailing production, while some, having arrived at an advanced age at which their physical stamina is not strong enough to withstand the discouraging situation, are not only disposing of their farms but are actually abandoning them and adding themselves to the already great army of unproductive people in the towns and cities.

In this situation the trite and familiar saying that "he who makes two blades of grass grow where one grew before" takes on a new meaning—a meaning not only of fame and altruism but of dire necessity to the human race. The chemist and the soil technologist must show how the farmer can produce more per acre; the engineer must devise machinery for the production of crops on an increased acreage with lessened labor; the physicist, chemist, and electrical engineer must show us how to get more and cheaper supplies of nitrogen; the plant breeder must develop more productive varieties of plants; and the zoologist and botanist must find better methods of protecting the crops produced from destruction.

It is not, however, in food alone that we are suffering from an underproduction. It is the same story in clothing, household furnishings, building materials, farm machinery, and other vital supplies; and in the face of it all the laboring element is struggling for shorter hours of labor and certainly in general a consequent lessened productive capacity per man. The laboring man of America appears blind to the fact that his higher wages, greater comfort, and general prosperity over that of his European contemporary have been due primarily to his greatly increased productive capacity under the conditions of industry as carried on in this country. And his utter fatuity in attempting to curtail the very thing that contributes to his well-being is one of the amazing things in the world today. In spite of this paradoxical attitude the laboring man is struggling for more leisure and seems destined to attain it.

THE PROBLEM OF INCREASING THE MEANS OF TRANSPORTATION

Turning for a minute to our second problem, the necessity of better and more economical means of transportation, let us recall briefly the conditions as they exist to-day. Competent authorities estimate that the country's transportation needs in the last six years have increased 45 per cent. while the railroad facilities have increased but 2 per cent. We are told that from 300,000 to 500,000 new freight cars and from 1,000 to 2,000 additional engines are needed at once while Europe is infinitely worse off than we are. It appears that some cities in southern Europe actually faced famine conditions for a time, at least, with supplies within reasonable distance but absolutely unavailable because no means of transportation existed to bring them within reach of the suffering community.

The transportation problem in this country has been developed by men whose principle aim in former years, at least, has been to make the railroads pay attractive dividends on the stock which has often been watered stock. The time has come, it seems to me, when the whole matter should be put on a thoroughly scientific basis by the technically, scientifically trained man. The permanent cure for many of the ills of transportation is to determine by careful scientific research and investigation more efficient and cheaper

types of power, fuel, engines, cars, and other equipment that enter into the problem. In other words, the costs of the means of transportation should be lessened rather than the price to the public increased. The answers to these questions will be obtained very largely by the investigator.

Intimately bound up with this whole question is that of public highways and their function as means of transportation. The motor truck or some similar and, I hope, more efficient vehicle, seems destined to revolutionize the methods of the interchange of products, certainly within the confines of reasonably limited areas. But in this matter, as in scores of others affecting intimately the welfare of mankind in this country, we have pursued a policy of *laissez faire*. We have bonded the state, taxed the people, built the roads, watched them crumble to dust and have then bethought ourselves of the desirability of an investigation of the principles of road making and of road materials. Unquestionably we shall awake in time to the necessity of a careful, thorough, extended investigation of the whole question of transportation. When that time comes the country will inevitably turn to the scientist for aid in solving the problem. The opportunity is inviting and I trust we shall have men trained for the work.

THE PROBLEM OF INCREASING THE SOURCES OF PHYSICAL POWER

The third problem to which I referred, namely, that of the need of increased or entirely new sources of physical force or power is a larger and really more basic question. The railroads of this country in 1918 used approximately 165,000,000 tons of coal. What the marine and stationary engines used during that year I do not know but the aggregate must have been large. From all of this vast amount of coal consumed in the United States for the purpose of generating force, approximately 90 per cent. of its heat was never delivered as mechanical power by the engines in whose boilers it was burned. What an overwhelming waste? And simply because of our present inability to avail ourselves of anything like the total inherent force or power that lies within this costly, steadily decreasing product, coal. In what dire need the world is of this latent but lost power! How much labor, energy, money, cargo-space, ships, and cars now used in mining and transporting coal could be devoted to other lines of industry and commerce if only one half of the latent power of this mineral could become available and that is the task that confronts the scientist. The last word on the means of utilization of this vast waste of power has certainly not been said.

Oil, our other great natural commodity from which we obtain physical power is already in greater demand than it can be supplied from our own fields. The situation is already acute and in less than a score of years the supply in the United States promises to be exhausted. Either new sources of oil must be found or some substitute must be produced.

Electricity, another of our great forces is now awkwardly obtained by expensively harnessing some mighty stream or by wasting nearly all of the latent power of coal to capture, as it were, this omnipresent, illimitable agency of force. There ought logically to be some method by which we could avail ourselves of this force in a more direct way—by reaching out, as it were, and taking it.

At the best then our present sources of physical power are very inadequately available or are hopelessly declining. In either event something must be done and done in the immediate future or we shall revert to semi-primitive conditions. It is to the scientist that we must look in large measure for the solution of this vital question.

In considering then, these three problems one can not fail to be impressed with the seriousness of the situation. In confirmation allow me to relate briefly a recent experience. Within the last week I received a letter from a company in New York City saying, "we can not make shipment of your material from New Jersey but we think we may be able to

send it from our stock here in the city if you are willing to pay the extra cartage." On the self-same day I received a notice from a company in Chicago saying, "the express companies are unable to handle express from Chicago to points in New York State." The next day the same company sent me notice that although they were preparing the order for shipment by freight the railroads in Chicago could not accept it at present and they feared there would be considerable delay in forwarding the order. These happen to be coincidents, indicative not only of the present condition of transportation but of much deeper and more serious social and political conditions. It is amazing and rather startling to awake and find that in this country of ours there is to-day but one agent of transportation actually and fully functioning—namely the United States Parcels Post. Unquestionably these conditions are partly due to the abnormal unrest in the minds of the people but what is much more serious, out of these conditions is bound to come further unrest, so that the end is not now in sight. In spite of one's faith in this beloved country of ours and in spite of one's boldest optimism one can not look forward without some fear and misgiving and our hope must rest very largely in the ability and the genius of our young men and women, especially in those who are trained to think and to work independently with the methods of research. If scientists can solve the problems we have touched upon they will not only contribute to the material welfare of the country but will also aid in allaying and finally settling the social unrest of the people. The obligations of the scientist in the upbuilding of peace are great and opportunity is knocking at the door of each one of us.

THE CONTINUED NEED FOR RESEARCH IN PURE SCIENCE

The discussion, so far, has turned mainly on what the world has long called, applied research. It seems to me that the term applied research is a misnomer and that it would be far more accurate and nearer the truth to designate it as research, applied. That is to say, in the solution of any problem by scientific investigation, no matter in what direction it may eventually tend, there must first be research, pure and intensive, accurate and often prolonged, followed if you please by an application of the principles so discovered. Thus we have had and must have in greater measure in the future, as I have already tried to point out, research, the resultant principles of which may be applied to the solution of economic problems affecting the public welfare. On the other hand, there is among men such a thing as research for the pure love of it. The characteristics, however, of such research do not lie in the method of work but rather in the spirit of the man doing it. The intensity of the work, the broadness of it, and the accuracy of it, do not differ one whit from the research work that may come to have an economic application. The differences between the two are psychological—attributes of the man. One investigator is absorbed in the beauty and sublimity of truth and in its discovery without any thought of aiding humanity while the other carries on his research with the hope that he may not only discover truth but that it may be of practical benefit to the human race. But these subtle distinctions if they really exist are of no consequence. What I wish to emphasize is, that work in pure science constitutes after all the most fundamental kind of research for humanity because it touches the spirit and the soul of mankind and everlastingly ennobles the human race. Pure research in science or in the humanities has been and still is the basis for all intellectual and moral progress and advance in enlightenment among all races and all peoples. And at this critical stage of civilization the spiritual force of this kind of intellectual activity needs new emphasis and added stress. The spirit of the pure scientist is the spirit that we desire to see pervade all humanity and all of the activities of humanity. It is a spirit of truth and honesty that tends to banish superstition, narrowness, greed, selfishness, and provincialism and to establish char-

ity, fairness, justice, and democracy. Indeed all high intellectual effort, whether in science or in the humanities, embodies this spirit. I can think of no happier illustration of this fact than the reply of the celebrated American artist, Edwin A. Abbey, when he was asked why he was so particular about the historical exactness of every detail, being assured that he was the only one who would know the difference. He replied by quoting the following verse:

In the elder days of art,
Builders wrought with greatest care,
Each minute and unseen part;
For the gods see everywhere.

He said:

It is because I can't forget those lines that I must make things as right as I know how, even if nobody is the wiser. "The gods see everywhere."

It is this spirit of honesty with one's self for the sake of honesty and truth that pervades all genuine intellectual effort, whether in science or in the humanities, and infiltrates into the body politic of a nation comprising true scholars among its people. It is one of the imponderables of civilization and the more our nation indulges in it and fosters it the higher will our civilization be.

The men who live in the hearts of the human race as a source of inspiration and greatness are those that have unconsciously contributed to civilization out of the greatness of their souls and their work. It is not the great financier, the captain of industry, or the merchant prince who lives through the ages, but rather the men who have "contributed materially to the fulfillment of man's destiny and bequeathed to future generations some new particle of truth, of beauty, of justice"—a Michael Angelo, a Newton, a Shakespeare, a Darwin, a Pasteur, a Franklin, a Lincoln. It is the spirit of such men that lives in a people and makes a nation truly great. Lowell in commenting on the industrial accomplishments of this nation put the whole matter most aptly when he said it is

with quite another oil that those far-shining lamps of a nation's true glory, which burn forever, must be filled. It is not by any amount of material splendor or prosperity, but only by moral greatness, by ideas, by works of imagination that a race can conquer the future. . . . Of Carthage, whose merchant fleets furled their sails in every part of the known world, nothing is left but the deeds of Hannibal. . . . But how large is the space occupied in the maps of the soul by little Athens. It was great by the soul, and its vital force is as indestructible as the soul.

This, I take it, is the spiritual force that we as students of the sciences must join hands with students of the humanities in maintaining and increasing in the world. And I am constrained to believe that, despite the apparent zeal for material development in this country, this spirit of moral greatness has ever been present here although, at times, it may have slumbered. If anything has been clearly demonstrated during the last five years it is that there are multitudes of young men and women that are ready and eager to give their all even unto death for truth and its corollaries, justice, freedom, and democracy. And it is appropriate that we here dedicate ourselves to the furtherance of this spirit and that we here resolve that we shall maintain it and if possible increase it in our beloved nation. It is you young men and women who must take the torch of intellectual idealism borne by many of your illustrious predecessors and pass it undimmed through the coming years to your successors.

GLENN W. HERRICK
CORNELL UNIVERSITY

USES OF PLANTS BY THE INDIANS

PROBABLY many who are interested in wild plants have wondered what uses were made of them by the Indians before white men came. Dr. Melvin R. Gilmore has recently published[1] such an account (relating chiefly to the region of Nebraska) which it has seemed desirable to review in the following form.

While we are familiar with the changes

[1] "Uses of Plants by the Indians of the Missouri River Region." In Thirty-third Ann. Rept. Bur. Am. Ethn. (1911–1912), pp. 43–154, 33 pl., 1919.

in the flora which have taken place since the occupation by white men, we know little of the influence of the natives previous to that time. The early explorers made little attempt to learn what the Indians knew about plants and since that time such knowledge has become increasingly difficult to obtain.

Their cultivated crops were corn, beans, squashes and pumpkins with several varieties of each; also tobacco (*Nicotiana quadrivalvis*), all probably of Mexican origin. Apparently they did not cultivate the wild plants which grew about them but must have scattered many of them by accident during their travels. Sunflowers were cultivated by the North Dakota tribes and some others, but not by those of Nebraska so far as known. Dr. Gilmore suggests that a sort of watermelon described by the different tribes as formerly cultivated among them may have been native to America. The chief evidence of this is the abundance of the fruits among various tribes as reported by early explorers.

About 200 species of plants are enumerated with notes upon their uses as well as the Indian names and their derivation in the Dakota, Omaha, Winnebago and Pawnee languages. In the following summary the plants have been grouped according to their uses.

Food.—In addition to cultivated crops, common wild fruits and nuts, the grains of wild rice, tubers of yellow lotus and roots of tipsin (Dakota name of *Psoralea esculenta*) were of special importance. The remainder include mushrooms (elm caps, morels, three species of puffballs, a bracket fungus, also corn smut), tubers of arrow-leaf, Indian potato (*Apios*) and Jerusalem artichoke; subterranean fruits of ground bean (*Falcata*), seeds of wild flax (*Linum lewisii*), berries of ground cherry (*Physalis heterophylla*), fruits of prickly pear, bulbs of wild onion and wood sorrel. Tender tops of lambsquarters and stem bases of bulrush (*Scirpus validus*); young sprouts, flower buds and green pods of milkweed; sugar from hard and soft maple, also box-elder. In time of shortage stems of prickly pear, fruits of wild rose and red haw were used.

The nutritious roots of tipsin were dug in quantities in spite of the difficulty of securing them. They were used fresh or peeled and braided in strings to dry for winter use. The tubers of yellow lotus, also the fruits of plums, sand cherries and chokecherries were dried for winter, the entire fruits of the latter being first pounded into a pulp.

Beverages, Etc.—Dried leaves of red root, fragrant giant hyssop and coneflower (*Ratibida*), also young leaves of wild strawberry and raspberry for tea; leaves of sumac, bearberry and bark of red dogwood for smoking; resin of compass plant and skeleton weed (*Lygodesmia*) for chewing gum.

Arts and Crafts.—Elm for lodge posts, mortars and pestles; osage orange for bows; ash for bows and pipe-stems; rough dogwood for arrow shafts; willow for baskets. *Yucca* leaves, nettle stems and inner bark of basswood for fiber, sloughgrass (*Spartina*) for thatching, big blue-stem (*Andropogon furcatus*) to support the earth covering of the lodges; bulrush stems for matting, birch bark for household utensils and torches. Lichens (*Parmelia borreri* and *Usnea barbata*), buds of cottonwood, roots of black walnut, blood root and sumac for dye. Roots of *Yucca* for soap; juice of prickly pear for mucilage; down of cat-tails for pillows and bandages; stems of scouring rushes for polishing. On the treeless plains *Yucca* leaves bound together served as a fire drill, the dried stem as punk.

Ornament.—Seeds of *Erythrina*, China berry and wild cucumber (*Micrampelis*) for beads, sweet grass, sweet clover, wild bergamot, fragrant bedstraw (*Galium triflorum*), fruits of meadow rue and prickly ash, seeds of columbine for fragrance; berries of pokeberry for stain. Of the wild bergamont the Pawnee recognized four forms which differed in fragrance.

Toys.—Pembina[3] stems for popguns, the wadding being nettle fiber, inner bark of elm,

[3] A corruption of the Chippewa name for *Viburnum opulus*. Dr. Gilmore states that it is already in use by the people of northern North Dakota and Manitoba, and suggest that it be adopted in place of the inappropriate "high-bush cranberry."

birch bark or tops of *Artemisia*. Cottonwood leaves for toy tipis and moccasins, the green pods for beads. Pods of spider bean (Pawnee name for *Acuan*) black rattle-pod (*Baptisia bracteata*) and little rattle-pod (*Astragalus carolinianus*) for rattles. Jack-in-the-pulpit seeds were used in gourds for rattles.

Medicine.—Roots of hop, canaigre, wild four-o'clock (*Allionia*), wind flower (*Anemone canadensis*), blue cohosh, wild black currant, wild liquorice, prairie clover, sumac, purple mallow (*Callirrhoe*), sweet cicely, cow parsnip, gentian (*G. puberula*), butterfly weed, bush morning glory, ground cherry (*P. lanceolata*), wild gourd, purple cone-flower, cup plant and burdock.

Leaves of red cedar, curled dock, pasque flower, wild liquorice, spurge (*E. serpyllifolia*), sumac, touch-me-not, verbena (*V. hastata*), wild bergamot, rough pennyroyal and fetid marigold. Tops of cow parsnip, wild mint, broom-weed (*Gutierrezia*), sticky head (Pawnee name for *Grindelia*), milfoil and wild sage (*Artemisia* spp.). Flowers of lily (*L. umbellatum*) and false lupine (*Thermopsis*). Berries of red cedar, seeds of hop and sunflower.

Corms of Jack-in-the-plpit and blazing star; rootstocks of sweet flag and blue flag; bark of roots of oaks and Kentucky coffeetree; inner bark of red elm, stems of skeleton weed.

The greater number of these were steeped in water and used for various ailments, most commonly fevers and intestinal disturbances. A few, such as sweet flag and purple cone-flower, were used in various ways. Cedar twigs, roots of purple mallow and cup plant were burned and the smoke inhaled for colds; flowers of false lupine were burned for rheumatism, the smoke and heat being confined to the affected part by a close covering.

Crushed leaves of dock were applied to draw suppuration, of sumac for poisoning, of touch-me-not for rash; roots of sweet cicely and cow parsnip for boils. Roots of butterfly weed were eaten raw for throat and lung trouble.

The fine stems of leadplant, rabbit foot (Pawnee name for *Lespedeza capitata*) and an aster were broken into short pieces, attached to the skin by moistening one end with the tongue, and burned for neuralgia and rheumatism. [This treatment, known as moxa, is found elsewhere and an Asiatic species of *Artemisia* is named *A. moxa*.] The collecting of roots of wild gourd and butterfly weed was done only by certain persons of the tribe.

Charms and Ceremonies.—Mystic properties were assigned to cottonwood, ash yellow lotus, wild gourd and cardinal flower. Flowers of pasque flower, spiderwort and wild rose were revered. Fruits of long-fruited anemone were used for luck at cards; seeds of columbine, love seed (*Cogswellia daucifolia*), roots of bloodroot and ginseng, roots and flowers of cardinal flower, plants of dodder and fuzzy top (*Artemisia dracunculoides*) for love charms. Sweet grass and wild sage (*Artemisia* spp.) for incense.

Poison ivy was known and dreaded. Moonseed was called "thunder grapes," "ghost fruit" and "sore mouth," while spurges and *Parosela enneandra* were regarded as of poisonous nature. The juice of red false mallow and purple coneflower were used to make skin insensible to heat. The compass plant was associated with lighting and its dried root burned during storms. Cedar boughs were placed on tipis for the same purpose.

O. A. STEVENS

AGRICULTURAL COLLEGE,
NORTH DAKOTA

SCIENTIFIC EVENTS

AGRICULTURE IN ALASKA

THE Department of Agriculture's experiment stations located in Alaska have demonstrated that Alaska is not only a food-producing country but that if the latent resources of the territory are developed the Alaska wheat fields are destined to play an important part in the economic life of the nation. The twenty-first annual report of the Alaska Experiment Station is now available. When it is considered that one of the experiment stations is located in the Yukon Valley only 75 miles

from the Arctic Circle, where the yearly frost-free period is about 97 days, some appreciation can be had of the difficulties that prevail.

According to the report, the Sitka station propagates and tests, and to some extent disseminates, all manner of plants that promise to be useful in Alaska. The chief line of work at the Fairbanks station is the growing of grain, the testing of the adaptability of varieties of grain, and the dissemination in small quantities of the surplus seed grain produced. At Rampart, the chief lines of work are the production of new varieties of wheat, barley and oats by means of hybridization, the testing and selection of hybrids, and the increase of those proving valuable. Hardy alfalfa is grown, as well as vegetables, for the purpose of ascertaining the best cultural methods to be pursued. Cattle and sheep breeding work is conducted at the Kodiak station, and at Matanuska experiments are made with growing grain and sugar beets. A small nursery has also been started here for propagating hardy nursery stock for distribution in the Matanuska Valley.

In 1918 a distribution of seed grain was made to a number of farmers in the Tanana Valley in an effort to induce them to begin grain production on an independent basis. The results were so satisfactory that the experiment was repeated in 1919. In that year 22 farmers in the Tanana Valley produced 1,128 bushels of spring wheat, 2,811 bushels of oats, and 121½ bushels of barley. During the same season the station at Fairbanks produced 303 bushels of spring wheat, 774 bushels of oats, and 125 bushels of barley. A small flour mill was installed at the Fairbanks station in 1918, where Alaska-grown wheat has been milled into an excellent bread flour.

The 1918 report of the Alaska Agricultural Experiment Stations can be had upon request of the United States Department of Agriculture, Washington, D. C.

REPRODUCTION OF MICROSCOPIC UNDER-SEA LIFE

The American Museum of Natural History has reproduced in glass and wax a two-inch section of sea-bottom, with its characteristic plant and animal life, magnified more than 15,000 times. The exhibit is known as the Bryozoan Group, taking its name from the sea-animals popularly called sea-mats and sea-mosses, which it principally depicts.

The shells of these minute organisms form encrustations on sea-weeds and pebbles and on shells of larger animals. They are extremely beautiful in their intricate form and coloring. The "plumed worm" has especially fine colors. Other microscopic creatures and marine plants combine to make this group of especial interest.

The glass-blowing was done by Mr. Herman Mueller, and the coloring by Mr. Show Shimotori, while the wax portions of the group are the work of Mr. Chris E. Olsen. The entire exhibit was prepared and assembled under the expert direction of Mr. Roy W. Miner, associate curator of the department of invertebrate zoology.

MATTERS OF SCIENTIFIC INTEREST IN CONGRESS[1]

The bill for a tariff on scientific instruments, etc. (H. R. 7785) was brought up on the Senate calendar on April 5, but was passed over. On April 28, Mr. Knox offered an amendment providing for the exemption from import duty of "guaranteed disks, ten inches or more in diameter, for astronomical telescopes."

The appropriations in the Second Deficiency Act include: \$75,000 for continuation of the investigation of the mineral resources of Alaska, to be available also during 1921; and \$47,100 for the continuation of magnetic and geodetic work by the Coast and Geodetic Survey.

The legislative, executive and judicial appropriation bill (H R. 12610), carrying appropriations for the Bureau of Standards, passed the House on March 4, and the Senate on April 1. After agreement to the conference reports the bill was sent to the President, carrying an amendment introduced by Mr.

1 From the *Proceedings* of The Washington Academy of Sciences.

Smoot on April 1 to the effect that no governmental journal, magazine, or periodical should be printed, issued, or discontinued without the approval of the joint committee on printing. On account of the inclusion of this amendment the President vetoed the bill on May 13. The paragraph was eliminated and the bill repassed and signed as Public Law No. 231.

The act includes $432,360 for salaries at the Bureau of Standards, together with many special research items of which the following are examples: fire-resisting properties of building materials, $25,000; development of color standards, $10,000; optical glass, $25,000; metallurgical research, $25,000; sugars and sugar-testing apparatus, $30,000; high temperature measurement and control, $10,000. Total for the Bureau, $1,217,360.

A joint resolution looking toward an even more comprehensive reorganization of the executive departments than that contained in the Jones-Reavis bill was introduced as H. J. Res. 353 on May 7 by Mr. Madden. The resolution provides for a Joint Committee on Reorganization consisting of three members each from House and Senate. Referred to the Committee on Rules.

Another reorganization and consolidation measure is S. 4369, introduced by Mr. Henderson on May 12: "To create a Division of Mines and Geology in the Department of the Interior." The proposed Division would be under the direction of an Assistant Secretary of the Interior, "technically qualified by experience and education," at a salary of $10,000. The powers and duties of the present Geological Survey and Bureau of Mines, and any powers and duties of other federal agencies relating to mining, metallurgy, mineral technology, geological surveying, land classification, or mineral resources, would be transferred to the new Division. The bill was referred to the committee on Mines and Mining.

THE MEETING OF ORIENTALS AND OCCIDENTALS IN THE PACIFIC COAST AREA

A SCIENTIFIC symposium on this subject will be held in San Diego and La Jolla, California, from August 1 to 13. It will consist of special technical discussions at Scripps Institution, La Jolla, and public addresses with opportunities for questions at the community center of the Unitarian Church, San Diego.

The initial assumption made for the discussion is: All particular difficulties rest back on a world problem of three-fold aspect: (*a*) The aspect of world population. (*b*) The aspect of world supply of "raw material" and "manufactured goods" for sustaining the world population. (*c*) The aspect of world civilization.

The program is as follows:

INTRODUCTORY

Statement, pro and con, of the troubles due to oriental migration, particularly into the Pacific Coast states of North America: WALTER B. PITKIN, school of journalism, Columbia University.

THE WORLD PROBLEM

(*a*) *In its population aspect (its numerical phase only)*: W. C. THOMPSON, sociologist, department of agriculture, Cornell University.

(*b*) *In its material supplies aspect:* E. M. EAST, plant genetics, Bussey Institute, Harvard University.

(*c*) *In its civilisational aspect:* WM. E. RITTER, biologist, Scripps Institution for Biological Research, University of California.

The general oriental-occidental problem: DR. GILBERT REID, director-in-chief, International Institute of China.

LOCAL ORIENTAL-OCCIDENTAL PROBLEMS OF PACIFIC NORTH AMERICA

(*a*) *"Cheap labor" problem; "standard of living" problem; "race prejudice" problem:* W. C. THOMPSON.

(*b*) *The general and special problems of rural life and agricultural industry:* ELWOOD MEAD, professor of rural institutions, University of California.

(*c*) *The "fertility" problem; the "miscegenation" problem:* S. J. HOLMES, department of zoology, University of California

(*d*) *The problem of conflicting national policies:* E. T. WILLIAMS, professor of oriental languages and literature, University of California.

SCIENTIFIC NOTES AND NEWS

Professor Leonard Eugene Dickson, of the department of mathematics at the University of Chicago, has been elected a corresponding member of the French Academy of Sciences. At a complimentary luncheon to Dr. Dickson at the Quadrangle Club, Professor A. A. Michelson, head of the department of physics, presided and welcomed Dr. Dickson to membership in the academy. Other speakers were Eliakim Hastings Moore, head of the department of mathematics; Thomas C. Chamberlin, former head of the department of geology, and Forest Ray Moulton, professor of astronomy.

At the eighty-eighth annual meeting of the British Medical Association, held at Cambridge, the president Sir T. Clifford Allbutt, chose as the subject of his address, "The Universities in Medical Research and Practise." At the conclusion of his address the president was presented with his portrait, the work of Sir William Orpen, which had been subscribed for by a great number of physicians. Sir Norman Moore, president of the Royal College of Physicians made the presentation address.

Dr. David Drummond, vice-chancellor and professor of the principles and practise of medicine, University of Durham, has been elected president of the British Medical Association and will preside at the meeting to be held next July at Newcastle-on-Tyne.

Among the foreign guests at the Cambridge meeting of the British Medical Association were: Dr. Simon Flexner, director of the laboratories of the Rockefeller Institute and Professor J. Abel, professor of pharmacology, The Johns Hopkins University.

Colonel F. F. Russell has resigned from the Medical Corps, U. S. Army, to take charge of the newly organized Division of Public Health Laboratories of the International Health Board of the Rockefeller Foundation.

Mr. E. A. Holbrook, formerly superintendent of the Pittsburgh branch of the Bureau of Mines, has been transferred to Washington as assistant to the director, Dr F. G. Cottrell, whose nomination has been confirmed by the Senate.

J. M. Hill, of the United States Geological Survey, has been transferred from Washington to the survey's office in San Francisco, where he will be associated with Charles G. Yale. Mr. Hill's field of geological studies will include the Pacific coast states and to some extent also Arizona and Nevada.

Mr. Alan Ogilvie who resigned the readership in geography of the University of Manchester, has joined the staff of the American Geographical Society of New York.

Dr. Seymour Hadwin has resigned his position as chief pathologist in charge of the biological laboratory, health of animals branch, Canadian Department of Agriculture, at Ottawa, and has taken a position as chief pathologist in the reindeer investigations of the Bureau of Biological Survey, United States Department of Agriculture, with headquarters at Unalokleet, Alaska.

Dr. S. Josephine Baker has been made consultant in child hygiene for the U. S. Public Health Service and has received a commission as surgeon in the reserve of the U. S. Public Health Service.

Dr. J. S. Flett has been appointed director of the Scottish Geological Survey and Museum to succeed Sir Aubrey Strahan.

Dr. Ludwik Silberstein, formerly of Adam Hilger, Ltd., of London, is now associated with the Research Laboratory staff of the Eastman Kodak Company. Dr. Silberstein is known for his mathematical papers dealing with electro-magnetism, optics, theory of relativity, projective geometry, spectrum theory, etc.

Dr. Harrison E. Patten has resigned from the Bureau of Chemistry of the U. S. Department of Agriculture, to accept the position of chief chemist with a St. Louis firm.

Kenneth P. Monroe has resigned as chemist in the color laboratory, United States Bureau of Chemistry, Washington, to accept a research position in the Jackson Laboratory of E. I. du Pont de Nemours Company, Wilmington, Del.

DR. W. VAN BEMMELEN, director of the magnetic and meteorological observatory at Batavia, Java, is visiting the laboratories and institutions of the United States.

DR. CHARLES D. WALCOTT, of the Smithsonian Institution, is spending the summer as in other years in geological and paleontological work in the Canadian Rockies.

DR. HUBERT LYMAN CLARK, of the Museum of Comparative Zoology of Harvard University, has been given leave of absence to be acting-professor of zoology at Williams College during the next academic year. He takes the place of Professor J. L. Kellogg, who will spend the year at Claremont, California.

DR. BARTON WARREN EVERMANN, director of the museum of the California Academy of Sciences, sailed for Honolulu on July 28 to attend the meetings of the Pan-Pacific Scientific Congress. The authorities of the Bishop Museum have asked Dr. Evermann, while there, to identify certain fishes in that institution. He will return to San Francisco about the end of August.

ACCORDING to the *Proceedings* of the Washington Academy of Sciences among those in attendance from Washington at the scientific congress to be held in Honolulu during August will be: Paul Bartsch, of the National Museum; William Bowie, of the Coast and Geodetic Survey; T. Wayland Vaughan, of the U. S. Geological Survey; H. S. Washington, of the Geophysical Laboratory, Carnegie Institution of Washington, and H. O. Wood, of the National Research Council.

DR. G. DALLAS HANNA and W. P. Zschorna, of the Bureau of Fisheries, have gone to the Pribilof Islands. Dr. Hanna has charge of the taking of the census of fur seals this summer; Mr. Zschorna is to continue experiments inaugurated in 1919 for improving methods of taking and curing sealskins.

DAVID B. REGER, of Morgantown, W. Va., is on leave of absence from the West Virginia Geological Survey for the next four months and will devote that time to consulting work in petroleum and coal. He has just completed a months trip to the prospective oil fields of Montana.

MR. H. P. v. W. KJERSKOG-AGERSBORG, assistant in zoology, Columbia University Extension Teaching, sails on the Swedish steamer *Drottningholm* for a six week's study of the Littorine Gasteropod fauna in fjords of arctic Norway. The Melfjord, which is the most southern of the arctic fjords offers an exceptional point of ecological interest owing to its greatly diversified type of shore-lines.

AT the annual meeting of the American Climatological and Clinical Association held in Philadelphia in June, the following officers were elected: president, Dr. Carroll E. Edson, Denver; vice presidents. Drs. Nelson Estes Nichols, Portland, Me., and Gordon Wilson, Baltimore, and recorder, Dr. Cleveland Floyd, Boston.

THE Eugenics Education Society has arranged for the holding of a summer school of eugenics and civics at Herne Bay College on July 31-August 14. The inaugural address will be delivered by Professor A. Dendy on "Evolution in Human Progress."

It is proposed by the Swedish Linnean Society to restore the old botanic garden at Upsala, together with the house in it, the former residence of Carl von Linné.

TRIBUTE to Wilbur Wright was paid by France on July 17, when a stone column supporting the undraped figure of a man was unveiled in the Place Jocobins at Le Mans.

THE Journal of the American Medical Association announces the deaths of the following men known for their contributions to medical science: Dr. Demons, formerly professor of surgery at the University of Bordeaux; Dr. T. Barrois, professor of parasitology at the University of Lille; Dr. R. Kretz, privat-docent of pathologic anatomy at the University of Vienna; Dr. T. Debaisieux, former professor of surgery at the University of Louvain, at one time president of the Belgian Academy of Medicine and of the Belgian Surgical Association, and Dr. F. Schatz, former professor of gynecology and obstetrics at the University of Rostock.

The death is also announced of Professor Max Fürbringer, the well known comparative anatomist of Heidelberg.

M. Eugene Aubourg de Boury died on April 17, in France, at the age of sixty-three years. A correspondent writes that M. de Boury, though a long-time invalid, had devoted himself with ardor to the study and collection of mollusks of the genus *Scalaria*. He gathered in the last ten years an extraordinary collection of these beautiful and rare shells for the Paris Museum of Natural History, increasing their series from 300 sets to 3,000, exclusive of photographs and illustrations of inaccessible species to the numbers of 1,800 more. This series far surpasses any other extant. He published numerous papers on the genus and indicated many new subdivisions of it, but the great monograph which was his ideal must remain for other hands to prepare.

Under the able guidance of Mr. Jasper E. Crane, a cellulose symposium was organized as a part of the program of the Division of Industrial and Engineering Chemistry at the St. Louis meeting of the American Chemical Society last April. One of the objects of this symposium was to ascertain whether a cellulose section, if formed, would secure the interest and support of a sufficiently large number of chemists. The object of such a section would be to promote intercourse and cooperation between the chemists in the various cellulose industries. This group constitutes one of the largest and most important of American industries; all branches of it are intimately concerned in the problems of cellulose, and it seems highly desirable to promote technical activity in this country along these lines. The proposed section would serve as a clearing-house for papers and information on cellulose technology, and should also play an important part in promoting research on the chemistry of cellulose. The symposium at St. Louis was distinctly successful, and it was voted to hold a second cellulose symposium under the auspices of the Industrial Section at the Chicago meeting during the week of September 6. At this time, the advisability of forming a permanent cellulose section will be considered. An interesting program is being arranged, and a large attendance of those interested in cellulose is anticipated. Titles of papers or suggestions for the symposium should be sent to G. J. Esselen, Jr., 30 Charles River Road, Cambridge, 39, Massachusetts.

The British Medical Journal states that the University of Paris has come to an understanding with the French government, through the minister of health, and buildings have been found in Paris which can be converted into a large institute of hygiene. It will be under the general direction of the professor of hygiene, Dr. Léon Bernard, but there will be five sections, each with its director. It will have sections of epidemiology, of social hygiene, food, of industrial hygiene, and of sanitary technology; and a series of laboratories—of bacteriology, chemistry, physics, and physiology—a museum, a library and lecture rooms. Courses of lectures of two standards will be given, the one elementary, for ordinary students of medicine, and the other advanced, for doctors proposing to specialize in hygiene. Instruction will also be given to persons employed in disinfection and as health and school visitors. It is hoped eventually to extend the opportunities for study by establishing courses for architects, engineers and statisticians. The food section will comprise three departments, the first dealing with the chemistry of foods and of adulteration, the second with the damage done by parasites and microbes, the third with the physiology of food and nutrition. An institute of hygiene on similar lines is also being established in the University of Strasbourg.

We learn from *Nature* that the bequests of the late Rr. Rudolf Messel include: £5,000 to the Royal Institution of Great Britain; £1,000 to the Chemical Society; £2,000 and his platinum still, "in which I carried out with W. S. Squire my experiments in connection with the decomposition of sulphuric acid," to Mr. Squire, requesting him on his death to leave it to the Society of Chemical Industry; his platinum

crucible to the Society of Chemical Industry; and his electric telephone by Reis to the Institution of Electrical Engineers. The residue of the property is to be divided into five parts, four of which are to go to the Royal Society and one to the Society of Chemical Industry, the wish being expressed that the fund shall be kept separate from the funds of the society the capital to be kept intact, and the whole of the income expended in the furtherance of scientific research and other scientific objects, and that no part thereof shall be applied for charitable objects, as the granting of pensions and the like.

THE *Journal* of the American Medical Association states that what is reported as the largest medical conference ever assembled in the capital of China was held February 21–28, of the present year. Over 300 delegates were present, including 210 medical missionaries. A message from the minister of education of China was read which stated the following as the educational policy for the immediate future in that country: (1) To establish new medical schools as soon as conditions will allow on the basis of one medical school for each province. (2) To improve and extend such schools as were already established. (3) To encourage the study of medicine and to maintain for the scientifically trained doctors a high social status aiming at a sufficient number for this important profession. (4) To cause to be organized at proper localities such institutions or facilities of investigation as will aid specialists in their own research work. (5) To regulate the practise of doctors trained in the traditional way with a view to the unification of standards required of medical practitioners.

UNIVERSITY AND EDUCATIONAL NEWS

IT is planned to establish eight new professorships at Cornell University to commemorate the war services of 7,800 Cornell men.

DR. H. R. KRAYBILL, of the Bureau of Plant Industry, has been appointed professor of agricultural chemistry and head of the department of chemistry of the New Hampshire State College.

P. W. WHITING, in charge of biology at Franklin and Marshall College, Lancaster, Pa., has resigned to accept a position at St. Stephen's College, Annandale-on-Hudson, N. Y.

PROFESSOR C. F. CURTIS RILEY has been promoted to a full professorship in the department of forest zoology, Syracuse University.

JOHN T. METCALF, Ph.D. (Yale, '13), psychological examiner with the Illinois Department of Public Welfare, has been appointed assistant professor of psychology in George Washington University.

DR. L. V. KING has been appointed Macdonald professor of physics at the Macdonald Physics Building, McGill University, from which he received his bachelor's degree in 1905. The chair to which Dr. King has been promoted has been held in succession by Professor H. L. Callendar, Professor, now Sir Ernest Rutherford, Dr. H. T. Barnes, Professor H. A. Wilson, and by the present director, Dr. A. S. Eve.

AT the University of Sheffield, Dr. W. E. S. Turner has been appointed professor of glass technology, Mr. J. Husband professor of civil engineering, Dr. Mellanby professor of pharmacology.

DISCUSSION AND CORRESPONDENCE

GENERA AND SUPERGENERA

TO THE EDITOR OF SCIENCE: I sympathize with Dr. Witmer Stone (SCIENCE, N. S., 51: 427, 1920) in his wish to preserve in generic names an expression of taxonomic relationships. Dr. Stone advocates the adoption of "an arbitrary set of genera *de convenience* so far as nomenclature is concerned and use subgeneric terms when we desire to call attention to more refined phylogenetic groups." I would call attention to the results of a practical application of this system. If I understand the proposed system correctly the genera for general use would stand toward the genera for technical use (since the latter

would be subgenera) in the relation of a supergenus to a genus. Suppose we apply this to the well-known genus *Panicum* among the grasses. There has been a tendency in the historical development of this Linnæan genus to split off one after another species or groups of species to form new genera. Even as limited by the avowed "splitter" the genus still includes hundreds of species. The more conservative botanists include as subgenera, *Digitaria* (*Syntherisma*), *Echinochloa, Trichachne* (*Valota*), *Thrasya, Echinolæna, Hymenachne, Sacciolepis,* and several more, in some cases, even *Setaria* (*Chætochloa*). I should be willing to use *Panicum* in the broader sense, but for the sake of consistency I should want to include under *Panicum* such genera as *Paspalum and Ichnanthus*. I think that the technical characters that separate these last from *Panicum* are no greater nor more important than those which separate *Digitaria* and *Echinochloa* from *Panicum*. But *Paspalum* and *Ichnanthus* have been considered distinct genera by most botanists for over 100 years. *Paspalum* is a Linnæan genus and includes probably more than 200 species. The practical question then arises, if the grasses are arranged in genera which are really supergenera on the basis of the relative importance of technical characters, the more technical groups appearing as subgenera, will the layman—or the botanist who is a layman in relation to the taxonomy of grasses—gain in convenience. Many well-known genera will disappear. *Bromus* and *Festuca, Sporobolus* and *Muhlenbergia, Trisetum* and *Deschampsia* (*Aira*), are as closely allied as *Panicum* and *Digitaria*. If *Digitaria* is placed as a subgenus of *Panicum* then one feels as if he must place *Sporobolus* as a subgenus of *Muhlenbergia* and so on. The layman is chiefly concerned with the stability of the names he uses. The method just outlined would, I think, be just as confusing to him as the "splitting" of which Dr. Stone speaks. It is very difficult to devise a nomenclature which shall adapt itself to the normal growth of a living science and yet have the kind of stability that the layman wants.

It has been assumed by some that the Linnæan concept of genera was a broad one, that his genera are what we are calling supergenera, and that later botanists have been splitting off fragments, or dividing along convenient cleavage lines, to form our modern genera. This assumption scarcely accords with the facts. He seems to have established genera according to his knowledge, his convenience, or sometimes apparently by a mere whim, if one is to judge by his grass genera. *Bromus* and *Festuca* are Linnæan genera that remain much as he left them; *Panicum* and *Andropogon* are supergenera; *Holcus* and *Aira* are assemblages of unrelated species or groups of species.

I believe there would be considerable confusion in the application of the concept of supergenera; and the names of the supergenera would be subject to continual change as our knowledge of relationships increased. Nevertheless, as a general principle, I think it is desirable to retain minor groups of species as divisions of genera rather than to recognize them as genera.

A. S. Hitchcock

Washington, D. C.

THE SITUATION OF SCIENTIFIC MEN IN RUSSIA

To the Editor of Science: In your issue of April 23 there is reproduced a letter from Professor Babkin, of the University of Odessa, in which the following statement occurs:

> The bolshevic revolution has brought Russia into such a state that not only has scientific work come to a standstill, but even our lives are in danger.

One is very much tempted to discuss the situation of scientific men in Russia, but it is perhaps better simply to quote testimony from impartial sources. There is, however, one remark which must be made with regard to Babkin's statement, namely, that Odessa is very far removed from the limits of the Federated Soviet Republic, being in the region (Ukraina) dominated by the anti-bolshevic forces.

I happen to have before me a book published recently by Gauthiers-Villars et Cie,

Paris, entitled "Etudes de Photochimie" par Victor Henri. The front page of the book bears this further legend: Professor Henri, formerly assistant director of the "Ecole des Hautes Etudes" (Sorbonne), and much to my amazement at present "Directeur de laboratoire à l'Institut scientifique de Moscou."

I open the book with curiosity and read in the preface that this great work on photochemistry was begun by the author in Paris but since the war "la photochimie fut oubliée." In 1915 it was Henri's good fortune to be dispatched to Russia on an official war mission. Then the revolution broke out and —but here I make room and let Professor Henri tell his own story:

La révolution russe arriva avec toutes ses phases. Un souffle de vie nouvelle se leva. Un espoir d'organization scientifique générale amenant le progrès, c'est-à-dire augmentant la somme de bonheur de l'humanité, se réveilla et une période de vie active commença en Russie, à laquelle je fus mêlé à Moscou. L'Institut scientifique de Moscou me donna un accueil très chaleureux; l'Université de Moscou m'offrit une chaire; la Commission de l'Académie des Sciences de Russie pour l'étude des richesses naturelles de la Russie me demanda d'être le secrétaire scientifique de la section de Moscou.

S. MORGULIS

THE CREIGHTON UNIVERSITY,
OMAHA

CONCERNING OUR RELATIONS WITH TEUTONIC SCIENTISTS

TO THE EDITOR OF SCIENCE: I fear that Professor Henry Fairfield Osborn's letter in SCIENCE, June 4, 1920, quoting from and commenting upon letters from my esteemed friend Arrhenius and another colleague, will convey to many readers an erroneous impression in one very important particular, namely: that there are scientists in the entente countries who would restrict the interchange of publications with scientists in the Teutonic countries. If there are any such entente scientists, I have not heard of them. I can safely parallel Professor Osborn's statement, "We paleontologists welcome the works of Othenio Abel," by saying that "We astronomers welcome the works of Struve (Berlin) and von Hepperger (Vienna); we shall read these works as carefully as we have read those issued by them in 1913 and earlier; and as soon as peace is declared we shall unreservedly do our part in arranging that Struve and von Hepperger and their colleagues receive the published writings of American astronomers.

In the relief of present-day distress and suffering in enemy nations, to which the quoted Stockholm and Vienna letters refer, I feel sure that all American scientists are glad to contribute in accordance with their abilities, and without question as to what occurred in 1914–18. I doubt if any appeal for assistance from this country has been made in vain.

There still remains the question of personal relationships in the future. Professor Osborn has quoted from one of the European letters as follows: ". . . *every German believed* [*in 1914*] *a war would be much cheaper than the steadily increasing military expenses.*" This undoubtedly assumed, on the part of "every German," that the war would be short, that Germany would win it, and that Serbia, France, and Russia would pay the bills! In this precise connection should the world be permitted to forget that Germany would not consent to a reduction of armaments when the other nations at the Second Hague Conference in 1907, made and urged this proposal?

Professor Foerster, of the University of Munich, was quoted throughout the world early in 1919 about as follows: "We Germans have only ourselves to blame for the *moral blockade* which hems us in, and the raising of this blockade depends upon ourselves alone." Whether the quotation is correct or not, it faithfully represents widely prevailing opinion in entente scientific circles.

W. W. CAMPBELL

MOUNT HAMILTON,
June 11, 1920

QUOTATIONS

MEDICAL EDUCATION

DURING the last thirty years the feeling has become increasingly insistent, both in this

country and in America, that certain radical reforms were needed in the methods of education in medicine. But our American colleagues have been fortunate in having the opportunity and the means for building new schools of medicine to meet the new circumstances and for making drastic changes in their methods of teaching which a variety of circumstances has hitherto prevented us from attempting in Britain. Now that the Rockefeller Foundation, by its magnificent generosity, has made it possible for us to embark upon the difficult sea of reform, it is particularly interesting and instructive to study the policy adopted in the more advanced schools of America during the twenty-seven years since the Johns Hopkins Medical School gave the study of medicine in America a new aim and a higher ideal. Though we are a quarter of a century behind our American colleagues in making a start, our delay has given us the advantage that we can profit by the experiments made on the other side of the Atlantic.

It is not generally recognized here how thoroughly the leaders of medical education in America explored every possible method of education throughout the world, and how much devotion and thought they have expended on experiments to discover, by truly scientific methods, how best to employ the few years that the medical student can devote to the training for his profession. Those who want to understand something of the spirit and the high deals that have inspired the American leaders in this great reform movement should read the account of their work and aims in the volume "Medical Research and Education," issued by the Science Press in New York in 1913. Briefly expressed, the matters upon which chief insistence is placed are as follows: The absolute necessity of (*a*) an adequate preliminary education and a serious university training in the basal sciences, physics, chemistry, and biology, without which foundation it is impossible for the student really to profit from his training in medical science; and (*b*) a method of practical teaching in all branches of professional work, whereby the student can, so far as possible, investigate for himself the facts and theories of each subject under the direction of men who are themselves engaged in research work, and not rely mainly upon lectures and demonstrations to give him merely the *results* of other people's work. In other words, the aim of the reform is to train the student in scientific methods rather than to "cram" him with traditional lore.

* * * * * * * *

The great development in the science of anatomy during the last thirty years has been due mainly to the use of the microscope for the investigation of the structure of the body and for the study of embryology. British anatomy has been hampered by the lack of the facilities for teaching these vital parts of the subject, and has suffered enormously from the lack of stimulating daily contacts with them. In other countries, and especially in America, the cultivation of histology and embryology has not only made anatomy one of the most active branches of medical study and research, but also brought the work of the department into close touch with physiology, biochemistry and pathology, to the mutual benefit of all these subjects, and especially to the student who has to integrate the information acquired in the different departments. It was the radical reforms effected in the teaching of anatomy by the late Professor Franklin Mall at the Johns Hopkins Medical School in 1893 that played the chief part in starting the great revolution in medical education in America. The stimulating influence of the abolition of the methods of medieval scholasticism in anatomy and the return to the study of Nature and to the use of experiment brought about a closer cooperation with other departments and a general quickening of the students' interest in the real science of medicine.—*Nature.*

SCIENTIFIC BOOKS

A new Morphological Interpretation of the Structure of Noctiluca and its bearing on the Status of the Cystoflagellata (Haeckel). By Charles A. Kofoid. University of California Publications in Zoology, Vol.

19, No. 10, pp. 317–334, one plate, two text-figures. February 13, 1920.

Professor Kofoid, the leading student of the Flagellata, in a brief but important paper, discusses convincingly the morphology and relationship of *Noctiluca*. The data and their bearing are well indicated in the author's summary, as follows:

1. Notiluca is a tentacle-bearing dinoflagellate with a sulcus, girdle, and longitudinal and transverse flagella.

2. The sulcus is longitudinal and midventral. It includes the apical trough and the recessed oral pouch and cytostome.

3. The tentacle arises from its posterior end.

4. The girdle has hitherto been overlooked. It is a shallow trough at the left of the sulcus and at right angles to it. It is seen best in small individuals.

5. The longitudinal flagellum is reduced and lies within the oral pouch. The transverse flagellum is represented by the prehensile tooth at the proximal end of the girdle at the left of the base of the longitudinal flagellum. This organ exhibits structural undulations and spasmodic or rhythmical contractions.

6. Distention by hydrostatic vacuoles, with flotation replacing active locomotion, has led to degeneration of the flagella and their reduction in size, and to the almost complete disappearance of the girdle.

7. *Noctiluca* belongs in the Noctilucidæ, a family of the tribe Gymnodenioidæ, with *Pavillardia*, another tentaculate, naked, non-ocellate dinoflagellate.

8. There is no morphological justification of a separate order of flagellates to hold *Noctiluca*, such as the Cystoflagellata Haeckel.

9. The Cystoflagellata may be retained as thus emended to receive *Leptodiscus* and *Craspedotella* pending discovery of their affinities.

MAYNARD M. METCALF
THE ORCHARD LABORATORY,
OBERLIN, OHIO

SPECIAL ARTICLES

THE EFFERENT PATH OF THE NERVOUS SYSTEM REGARDED AS A STEP-UP TRANSFORMER OF ENERGY

THE properties of nervous tissue which fit it for its peculiar rôle in the animal economy are given by Sherrington as (1) excitability (2) spatial transmission of impulses and (3) control of the liberation of energy in contiguous tissues. Pawloff and others have emphasized the rôle of the peripheral sense organs as energy transformers, since the energy of light or heat or sound is transformed, by appropriate mechanisms, to the energy of a nerve impulse. Lucas and Adrian's all or none hypothesis of nerve conduction calls attention to another aspect of the work of the nervous system as a transformer of energy. According to this hypothesis, the nerve impulse conducted by any single nerve fiber is at all times the maximum impulse which it is capable of conducting. The evidence in favor of this view appears to be steadily accumulating, although there are still conditions under which the energy relationships are not clear. The efferent paths of the nervous system appear to me to furnish additional confirmation of the general truth of the hypothesis.

Neurologists have frequently commented on the relatively few nerve fibers in the main motor tracts of higher animals, *i. e.*, the pyramidal tracts, as compared to the number of fibers in the ventral roots of the spinal nerves and the great mass of muscles to be activated. According to von Monakow, Redlich, Schäfer and others, fibers of the pyramidal tract do not end directly about the cells of origin of the motor nerves, but about some intermediate or intercalated cells in the spinal cord. Von Monakow has supposed that each of these intermediate cells comes into relation, through the branching of its processes, with more than one motor cell in the spinal cord. Furthermore, the axone of each peripheral motor nerve may branch on its way to its effector. There is a possibility, therefore, that each descending fiber in the pyramidal tract of the spinal cord may ultimately be able to actuate several terminal axones in the peripheral motor system. Suppose that one pyramidal fiber may, through the intercalated neurone, come into relation with three cells of origin of peripheral fibers,

and that each of these peripheral fibers, in its turn, is divided into two. These relationships may be indicated diagrammatically. One pyramidal fiber may, therefore, be represented

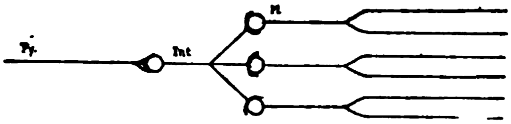


FIG. 1.

at the periphery by six branches of axones, each of which is in its turn capable of acting upon an effector. The energy, *a*, coming down the first fiber in the series, *Py*, is, according to the all or none hypothesis, the maximum which the fiber is capable of conducting. Similarly, the energy passing over the intercalated (*Int.*) fiber before its branching is also the maximum which it is capable of conducting. Suppose that it is equal to *a*. At the point of branching, the energy conducted along each branch must either be brought up to some quantity closely approximating *a*, or else it must fall to $a/3$. In the latter case, the energy passing over the proximal unbranched portion of the fiber *M* must either be brought up to the value *a*, or else in its turn be close to the value $a/3$. Going on out to the bifurcation of this fiber, there must again be a raising of the energy in each of the branches to some value closely approximating *a*, or else it must fall to a value $a/6$. There is little or no evidence that the energy of the nerve impulse falls off in any such degree in its passage from central system to periphery. The presumption is, therefore, that the efferent distribution path acts as a step-up transformer of energy, although the manner of its action is as yet unknown. It should be stated here that the nerve fiber itself furnishes the energy, derived in some manner as yet unknown from its own metabolic processes, and that there is, in all probability, no change in voltage at the expense of the amperage, as in the electrical transformers with which the physicist is familiar.

Reference to Ranson's[1] diagram of the sympathetic system will show that the same considerations apply there. In fact, the diagram given in this paper was suggested by Ranson's diagrams.

One more link in the scheme of the step-up transformer may be what Langley has called the receptive substance, interposed, chemically if not histologically, between the motor end plates and the contractile substance in muscle. It is certain that there is a great increase in the energy of a muscle contraction as compared with the energy of the nerve impulse, which, starting in the central system, finally evokes the muscle contraction at the periphery. It seems reasonable to suppose, in the light of our present knowledge, that the efferent nerve path is a part of this transformer system.

Such general relationships of the energy of the response to the energy changes in the processes preceding the response have long been recognized. Balfour Stewart[2] (p. 163) remarks: "We have seen that life is associated with delicately-constructed machines, so that whenever a transmutation of energy is brought about by a living being, could we trace the event back, we should find that the physical antecedent was probably a much less transmutation, while again the antecedent of this would probably be found still less, and so on, as far as we could trace it." We should recognize, however, that such relationships have a limit in the living organism. Otherwise, we would arrive at perpetual motion.

F. H. PIKE

DEPARTMENT OF PHYSIOLOGY,
COLUMBIA UNIVERSITY

ON SPIRAL NEBULÆ

ONE of the privileges of the vacation is the opportunity of making one's own tea in one's own vessels. I did so recently, aided by a deep precipitation glass, *g*, with a lip, *l*, running far down the sides. On stirring the

[1] Ranson, S. W., 1918, *Journal of Comparative Neurology*, Vol. 29, p. 306.

[2] Stewart, Balfour, 1874, "The Conservation of Energy," New York, p. 163.

liquid with a spoon, energetically, and removing the latter, I noticed that a sharply outlined spiral was *persistently* present on the surface, until the deep paraboloid returned to the plane. My explanation would be, that at *l*, part of the tangential velocity is converted into local vortical motion, whereby the particles at *l*, because of the reduced centrifugal force, slide down the inclined plane of the rotating paraboloid. From another point of view, a stationary wave is produced on the surface by the interference at *l*.

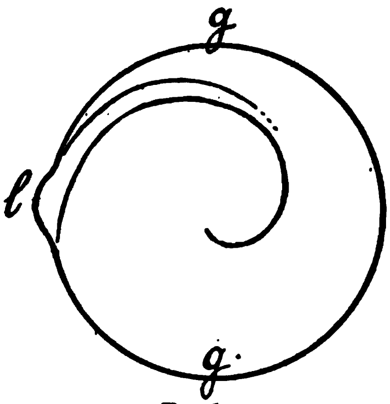


Fig. 1.

Now though I will not venture to repeat the superscript of this note, I will nevertheless ask whether something analogous to the above simple experiment may not be taking place in astronomical space. Suppose we replace the glass vessel of the figure by a gravitational mechanism; and suppose we "lip" it at *l*, by making that locality a region of effectively greater density and relatively at rest. If Kepler's law be written in the form so convenient in its present relations to the modern atom (M, being the virtual mass at the center and A the angular momentum per gram, whereby $rv^2 = A^2/r = M$, for the tangential velocity v at r), then any local diminution of A in accordance with the above model, would be followed by a diminution of r in the part affected.

At all events the hydrodynamic experiment (rotational surface figures, as related to shape of boundary) is very beautiful and certainly more approachable. I shall allow myself to play with more interpretable modifications of it a little longer.

Carl Barus

Brown University

THE PACIFIC DIVISION OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The Seattle meeting of the Pacific Division of the American Association for the Advancement of Science held June 17 to 19 at the University of Washington, Seattle, was perhaps the most successful so far held by the Pacific Division. Sixteen affiliated societies were scheduled in the final program and delegates were in attendance from every part of the Pacific Coast area. The representation from the University of California and Stanford University was particularly large.

The special sessions of the convention in which the various affiliated societies participated were well attended and the beneficial results of this cooperation were apparent. The conference of Research Committees from the educational institutions of the Pacific Coast held two sessions which were attended by all the delegates. The problems connected with the maintenance and encouragement of active research in the college and university were presented and discussed and some practical suggestions were made. It was felt that distinct progress in the solution of these problems had resulted from this meeting and that the research conference should be a permanent feature of the annual meetings of the Pacific Division.

A symposium on the "Einstein Theory of Relativity" was of general interest and was also well attended. In the symposium on "The Animal and Plant Resources of the North Pacific Ocean" given under the auspices of the Pacific Fisheries Society and the Western Society of Naturalists, each speaker emphasized the great need for more knowledge of the ocean and its life to save the fisheries industry. It is hoped that the means will be found to publish the papers in this symposium as a contribution to a better understanding of the importance of the projected exploration of the North Pacific Ocean through international co-

operation. This project will be further advanced at the Pan-Pacific Scientific Congress to be held in Honolulu from August 2 to 20.

Notable features of the meeting were the presidential address by Dr. John C. Merriam who spoke on "The research spirit in the every-day affairs of the average man" and the address by Professor R. W. Brock, of the University of British Columbia, on "The last crusade under Allenby." On account of illness, Dr. Charles E. St. John, of Mount Wilson Observatory, was unable to give the Sigma Xi-Phi Beta Kappa lecture. His place was supplied by Dr. Paul W. Merrill, of Mount Wilson Observatory, who spoke on "The chemistry of the stars."

Dr. William E. Ritter, director of the Scripps Institution for Biological Research, was elected president of the Pacific Division for the year 1920-21. Dr. William M. Dehn, professor of chemistry, University of Washington and Dr. E. P. Lewis, professor of physics, University of California, were elected members of the executive committee to serve five years and Dr. E. C. Franklin, professor of chemistry, Stanford University, was elected a member of the executive committee to fill the vacancy caused by the election of Dr. Ritter to the presidency.

The officers of the Pacific Division for the coming year are accordingly as follows:

Dr. William E. Ritter, president, Scripps Institution for Biological Research, La Jolla, Calif.

Dr. Barton W. Evermann, vice-president and chairman of the executive committee, California Academy of Sciences, San Francisco, Calif.

W. W. Sargeant, secretary-treasurer, California Academy of Sciences, San Francisco, Calif.

MEMBERS OF THE EXECUTIVE COMMITTEE

Dr. Barton W. Evermann, chairman, California Academy of Sciences, San Francisco, Calif.

Dr. William E. Ritter, Scripps Institution for Biological Research, La Jolla, Calif.

Dr. W. W. Campbell, Lick Observatory, Mount Hamilton, Calif.

Dr. William M. Dehn, University of Washington, Seattle, Wash.

Dr. E. C. Franklin, Stanford University, Calif.

Dr. C. E. Grunsky, Mechanics Institute Building, San Francisco, Calif.

Dr. T. F. Hunt, University of California, Berkeley, Calif.

Dr. E. P. Lewis, University of California, Berkeley, Calif.

Dr. D. T. MacDougal, Desert Laboratory, Tucson, Arizona.

An amendment to the constitution of the Pacific Division was proposed in executive session held Thursday evening June 17 to exclude Arizona and the states of Chihuahua and Sonora in Mexico from the territory of the division. This action was in conformity with that taken by the National Council which has caused these states to be included in a recently organized division of the American Association.

As an encouraging sign that the purposes of the annual meeting are being in some measure fulfilled it is noted that considerable publicity was given to the meeting in the Seattle papers. At least two editorials appeared on topics related to the discussions and reports of the meetings were given in some detail. This would indicate that the public is becoming more generally interested in the progress of science and augurs well for the future support of scientific investigation.

Announcement was made by the executive committee that the next annual meeting would be held in the San Francisco Bay region, the definite time and place to be determined later. This location will accommodate the largest number of members and should insure a good attendance for the 1921 meeting.

W. W. Sargent,
Secretary

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, AUGUST 6, 1920

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

MEDICAL RESEARCH[1]

I HAVE said that I would not plunge with you this evening into the ocean of science; but if you are a little tired of hearing of the dependence of medicine upon science you may find refreshment or diversion in contemplating the debts of science to medicine. My old medical friend Mr. Meade, of Bradford, was almost the only man who knew much about flies at the time when Manson and Ross began to watch these little pests. Without medicine, bacteriology and the study of the cell would have made slow way; yet it is the study of the cells of bacteria, of algæ, of protozoa—not of mandarins—which has brought us nearer to the secret of life. On the wonderful world of the cell I have spoken before. Professor Hopkins has lately described to us the almost incredible coexistence in it of different constitutions, phases, and events; though every change in any phase affects the equilibrium of the whole cell system. And every one of these is essential to the whole; "so long, for example, as a liver cell remains alive its glycogen constituent can not be wholly removed." If a cell be so ground up as to become more homogeneous, its reactions fall out at haphazard, and the cell dies by mutual destruction of its parts. This process of nature is illustrated on a mighty scale to-day in the disintegration of the Russian social organism.

Some of the apparently simple cell constituents, hæmoglobin for instance, are incredibly complex; this substance is specific for every kind of animal; in allied species, if concordant, it is not identical. Of the chromosomes I need say nothing; except to hope that as X rays have analyzed crystalline structure some such rays may analyze nuclear constitutions.

By another way, medicine has promoted research on organic syntheses; and conversely on

[1] From the address of the president of the British Medical Association at the Cambridge meeting.

the reduction of foods into the more complex amino-acids before being rewoven into the tissues of life. From medicine began our recognition of the plowman as the first parent of animals and man, and our fuller knowledge of "the green plant as the fundamental capitalist."

> Herbs gladly cure our flesh, because that they
> Finde their acquaintance there.

In the dark soil the nitrifying bacteria live on inorganic matter; so in the light some inorganic colloidal systems can build up formaldehyde (B. Moore). Medicine has introduced the chemist to the domain of the hormones and chalones, themselves also bodies of the simpler chemical constitution—some crystallizable, all able to resist prolonged boiling—blended into a wonderful physico-chemical coordinating system, secretly at work all the time under the diagrams of the innocent neurologist. We may suppose indeed that every active tissue of the body, or every cell, even of bone and skin, or of the substrate of mind itself, like every individual of a social organism, contributes some element to the organic whole, some inward production necessary for growths, or for signals.[3] There may be a world of pathological (alien or perverted) hormones as yet unexplored. May the dive inwards of epithelial cells in cancer be due to some inversion of chemotaxis, possibly under the influence of an alien (parasitic?) enzyme? Within the body then all parts are the "environment" of each—so that we have both an inner and an outer "climate," an aspect of the microcosm not to be forgotten in the field of mental disease. Thus it is that "Each part may call the farthest, brother." And these agents have a field of action far beyond the body, as we see for example in the sexual hormones. If there be a "migration hormone" its sphere is the world.

Again, is it not largely by medicine that the study of enzymes has thrown light upon the operations of catalysis which, like the rollers under a log or, as we now think, more by engagement and disengagement like rack and pinion, is incessantly forwarding, by various intermediate series, and by reversible actions at points of concentrative equilibrium, the processes of nature? The vitamines may be of this kind, agents which have upset our cruder calculations of nutritive values; for instance, in the feeding of children, we no longer take cane sugar to be the vital equivalent of lactose, nor margarine of butter; not all the nitrogen of nutrition is included in protein, nor are phospho- and amino-lipins, nucleic acid, amino-acids, and so on, mutually convertible in the body. We must admit that the fundamental principles of nutrition have yet to be redetermined. Moreover the war has forced us to remember the mutual dependence of food kinds; that of course fats and carbohydrates are not wholly independent or equivalent; the carbohydrates can not make up any great lack of fats, nor can oxidation of fats proceed in the absence of carbohydrates.

Another system of balances in the body, as of the reciprocal functions of lung and kidney, is more obviously chemical. Medicine has taught us how the lung deals with the CO_2 ions, the kidneys with sundry other acids, so that the blood reaction is maintained with extreme nicety; and that other systems—for example, the vasomotor—are probably little less sensitive, and that there are other subtle causes of anoxaemia besides the cardio-pulmonary (Haldane); so that in medicine it is of the first importance that in all abnormal conditions the oxygen tension of bloods should be systematically ascertained and compared. The hydrogen ion concentration is consistently higher upon flesh diet, lower upon vegetable diet; but I think we have not yet learned to discriminate so subtly as Charles Kean who is said to have chosen his viands according to the parts he had to play—pork for tyrants, beef for murderers, mutton for lovers.

Next after the origin of life itself, from ancient times to this day no enigma has attracted and baffled the curious mind of man more than that of living "form." Many of our keenest minds—Haldane, D'Arcy Thompson, Osborn, Dendy, McBride, I mention a few

[3] Mathews, "Physiological Chemistry," second edition, p. 835.

names as they occur to me—are still chasing this will-o'-the-wisp; and moth-like I can not but flutter after them. Of the nitrifying bacteria which assimilate inorganic matter, of the synthetic amines of animal nutrition, of the properties of colloids, I have spoken already to-day and last year; but "how," says Dr. Haldane, "is constant form maintained amid the continuous changes of our changing matter?" and—I may add—of variations of parts. Is "form" something after the manner of seal, which is impressed upon matter? or is it, in Aristotle's sense, a kind of soul (entelechy) which shapes the potential, or capacity, into integral being? Here we hover between metaphysical or ontological concepts and natural law, or the properties of matter. A few years ago all notion of self-shaping was dismissed, and the animal regarded merely as a diagram of incident forces; to-day there is some harkback, if not to moulding entities, at any rate to some phases which partake both of germ and matrix. We had been taught that for development functional stimuli were all that was necessary; for instance, that the heart grew, even beyond the normal, only in response to demand for its work and by increased supply of blood to its tissues. But is there any functional adaptation from within? If a limb be not used the bone will still grow more or less; but why does the bone grow *round?* And an eye will grow, from a germ of it, in the dark (Loeb). Is there such a property in living matter as "functional adaptation"? Is function in its effect upon form adaptive or purposive? Is environment met by adaptive variation—for instance in a germ cell? Again, if so, can specific properties of such a kind be acquired? Biologists seem to have proved that evolution of form may go on continuously when environmental change is suspended, or remains constant; and conversely that environmental change does not necessarily induce evolution. On a broad view, says Professor Osborn,[3] during the infinite variety of the widely diverging forms of the Mammalian period of the earth, the reptiles have shown very little change. We perceive that these questions arise in some contrast with the hypothesis of the selection of "chance" variations.

On the other hand, we find reason to marvel at the constancy of bacterial species; humble and embryonic beings that we should not expect to have become fixed in their habits. Yet they and their enzymes are very exacting about it; as we find, for example, with the several enteric bacteria, or with the meningococcic or pneumococcic varieties, of which each has its own serous or agglutinin test, and is indifferent to the rest. And there is more still to be said: when the microbe finds itself in the host's body it may be wholly out of tune, or wholly in tune, with any or all cells that it approaches; in either case presumably nothing morbid would happen, perhaps, by a kind of zygosis, a benefit; morbid happenings would lie between this microbe and body cells within its range but not in tune with it. Now there seems to be reason to suppose that a microbe, on its approach to a body cell only just out of its range, may try this way and that to get a hitch on. If so, the microbe, at first innocuous, would become noxious. So on the other hand body cells may educate themselves to vibrate in harmony with a microbe before dissonant; or there may be mutual interchange and coadaptation. Such considerations arise out of many known phenomena at phase boundaries, of sympathetic vibrations, of acquired immunity, of new virulences, and so forth; the cells out of tune getting nearer and nearer into consonance with each other.

But, if things be so, surely we are face to face with a marvelous and far-reaching faculty, *the faculty of choice,* and this rising from the utter bottom of biology to the summit—formative faculty—"auto-determination," or, if you please, "mind." Can the microbe do as the retriever does when with a hare in his mouth he comes to a gate; he tries this way and that, then thrusts the hare under the gate, leaps over and pulls the hare through? So the microbe tries it on, this way or that, till it succeeds, by self-education in the school of experience—*Bildungstrieb.* This is far more—radically more—than *"élan vital";* not

[3] Osborn, "Origin and Evolution of Life," p. 137.

merely energy but *choice*—plasticity driven to choose or fail; thus new devices are tried and new habits established. So likewise Dr. Topley has dwelt upon a microbe acquiring a capacity to bring about certain fermentations,[4] an ability, as he says, "to be regarded as something inherent in the organism itself." We may be reminded also of Professor Stanley Gardiner's "education" of his oysters—a very curious observation.

So far as I can think upon it there seems to be but one alternative hypothesis, but this does not cover so many phenomena. As I have said, if the vibrations of an alien cell are out of range of a certain body cell so as just to be indifferent but yet not far out of range, the vibrations of the one might induce like vibrations in the other, and meanwhile interference waves would arise in the field; thus disturbances—symptoms—would begin and continue until the two sets of waves should blend into unison; and this would mean acquired immunity. If a number of wag-at-the-wall clocks are hung near each other, in a calculable time they will get to swing in unison. But this hypothesis does not lead on, as does the trial and error hypothesis, to larger and larger gains. We see only a discord and a mode of requiescence; no line of development. What we apprehend is something more than orderliness of chemical reaction; that *cells are teachable;* a key to illimitable progress. Was not Coleridge right when he said

For I had found
That outward forms, the loftiest, still receive
Their final influence from the Life within.

I am not for one moment forgetting that the physical modes of energy—adsorption, surface tension, and so forth—may count for much in these advances, arrests, immunities, and disintegrations. Adsorption, or other physical condition, may put up a block. How remarkable are the effects of anesthesia and palsy which may follow injections of sodium oxalate and magnesium sulphate, and of their quick removal by calcium salts; indeed the whole influence of calcium on metabolism—probably all of them surface (interface) actions, as of any radio-active element upon cell function.[5] Indeed, as in the relation of foodstuffs to amines, so in the physics of the cell we may discover a comparative accessibility and intelligibility of the processes of life—Poincaré's "*simplicité caché.*" It seems that God has more "respect to the measure and ease of the human understanding" than Boyle supposed.

Thus we are led to the thaumaturgic word "Research" which, for some of us, means remote and rather unreal speculations; for others the discovery of short cuts to making more money; for others again the ideal of pure knowledge. Research may be regarded as of two kinds, as natural observation and as artificial experiment; the one yielding more and more to the other as investigation penetrates from the more superficial to the deeper processes. Still, if we are to surprise and "capture wild nature in her secret paths," the two ways are strictly inseparable. Indeed the infinitely little does man more harm than the enormously great. War may bring with it some redemptive virtues; pestilence only raw superstitions. The advance of the last half century from the deadhouse pathology to more refined and penetrating methods we have witnessed in our time, and yet more intimate methods, those of biochemistry for instance, are being rapidly unfolded. Research, as it is working to-day, advances from fixed and measured bases; as observation it watches nature's march past; then as experiment it puts events to test under artificial conditions of separation or isolation, and measures their phases. But the laboratory can not, as nature does, contrive the unexpected; so we must "gear up our tiny machines to the vast wheel of nature," and try for a first roughing out of an idea or concept. If we are to select our facts to any considerable purpose as crucial, we must first have an idea in our minds; and for this a certain kind of imagination is needed, one of general concepts rather than of the concrete individualizing imagination of the artist. Thus there

[4] *Lancet*, May 22, 1920, where he quotes "Penfold and others."

[5] Gates and Meltzer, Rockf. St., Vol. XXV., and *Jour. of Physiol.*, February 20, 1920.

are two kinds of discoverers, whose comparative outlines we have not yet well discerned. Of scientific discovery Henri Poincaré gives an interesting appreciation; he says that discovery consists of three stages: the first stage is of laborious work at the problem on all sides; the next is not one of conscious occupation with the subject, but of unconscious cerebration, during which a promising hypothesis may unexpectedly arise in the mind; the third is deliberate verification and completion of form. Thus out of an unlimited number of possible combinations, and by many speculations, the discoverer at length divines the true one. In medicine this has been clearly the course of surgery, the side of medicine which is closer to nature.[6] The surgery of my young days was only too "observational"; the friendly fingers of curious colleagues were popped in and out of an operative incision with no apprehensions about "the infinitely little." Now the observer is sadly pushed aside; the ritual of surgery is become like the magic rites of old of which, if a point were dropped or a word changed, the virtue went out. But the rite could be done over again by the penitent; unluckily in surgical rites there is little room for repentances.

A new scheme of research into the origin of diseases, lately instituted at St. Andrews, claims our respectful attention. And may I be forgiven if here I pay a tribute to the rare devotion which inspired Sir James Mackenzie to forsake place and honor to follow after knowledge; indifferent whither he were led so long as truth was the leader. Sir James argues that the man in charge of the first deviations from health is the general practitioner; and that, if we are to detect diseases in their incipience, he must be the detective. One evening about the year 1879, when staying with Sir George Humphrey, he and I sat into the small hours devising a method by which we hoped to engage the general practitioner in scientific investigation. We secured the cooperation of this association and of many coadjutors;[7] Dr. Mahomed joined us as secretary. We hoped by gathering in large numbers of observations to eliminate error; and several series of questionnaires were distributed. Four volumes of reports were issued, under such editors as Humphry himself (on Old Age), Butlin (on Cancer), Whipham (on Rheumatic Fever), and Isambard Owen (on Intemperance). But the effort was premature; the data were too rickety, the reports too often irregular, dilatory and imperfect, and the reporters untrained in observation, punctuality and precision. As things are, few of our colleagues remember to let us know the issues of cases seen in consultation. We may hope now for better material and more accurate workers; not only so, but Sir James Mackenzie is developing another and no doubt better method; he is working with intense culture, on a small holding, and on a more intimate clinical plan.

In exploring a country the great watersheds and rivers are first laid down; to map out these and their valleys and tributaries is the first great work. These main features known, bearings are obtained whence to discover the contours of the hills, and to track up to the hidden sources of the streams. This is Sir James's mission—to track out the nascent rivulets, and with his divining rod to dig for the springs which feed the streams of disease.

Let us not suppose that this research will be but a matter of cleverness, sagacity, or even of intensive observation; nor flatter ourselves that because Mackenzie produced his great work on the *Pulse* while a general practitioner that he achieved this by ordinary clinical observation, however acute The progress of medicine must in large part be endogenous. While our pathologists in balloons were working on morbid phenomena without ever seeing a sick man, Mackenzie was bringing laboratory equipment, and exquisite laboratory methods, to the bedside. The polygraph, no easy instrument to handle even now, was the grandchild of the kymograph; and by it was

[6] See C. A., "Hist. Relations of Medicine and Surgery."

[7] See Sir G. Humphry's presidential address at Cambridge, 1880.

proved again that science consists—as Plato said five centuries before Christ—*in measurement*. So in the St. Andrews research, not only have the initial warpings to be discovered, in their many ways and tides, but their volumes and their curves also to be measured as precisely as were those of the circulation by the polygraph. The physicist and the biochemist will need all their expertness in valuing molecular motions, analyzing secretions, recording blood tests and morphologies, and so forth, in their earliest and subtlest phases. For it is in molecular dynamics that the first deviations will arise; massive visible changes come later, and happily are now in large part calculated, or calculable. Mere observation—Nature's march past—will not count for much now; and as to family histories—well, they vary with each historian. And we practitioners will need a more searching discipline before we can occupy ourselves with problems so subtle.

The laws of inheritance must, I think, be sought out, at any rate at first, on animals; the generations of man are too long for comprehension; besides, something else seems lacking in this study of the genetics of man? . . . Is it a sense of humor?

And there is something more to be said. If light is to be thrown upon the generation of diseases in man it must be in part also by study in a far larger field; we must discover and compare the elements and phases of disease in animals and in plants. Sir James Paget, in his admirable address to the Pathological Section of this Association at Cambridge in 1880, reflected on the difficulties of human pathology because of its great complexity. He had "long and often felt that in this difficulty we might gain help from studying the consequences of injury and disease in the structure of plants" as less complex and under simpler conditions. To this field of pathology he devoted almost the whole of the address. A large part of my address in medicine to this association in Glasgow in 1888 was given to this appeal; it has found no response, hardly an echo. Yet what would anatomy be without comparative anatomy; language without comparative philology; anthropology, law, history, and even religion, without a like comprehension? Without an *Institute of Comparative Pathology* in Cambridge our range of vision and work is contracted. In the "Field Laboratories," it is true, Professors Woodhead and Nuttall, ably seconded by Dr. Stanley Griffith, are doing as much as lies in the power of a few individuals; but any such effort is puny beside the sphere of observation and research awaiting us. The comparative survey must cover the diseases of plants as well as of animals; of the lowest of living things up to the highest. The money loss year after year caused by the depredations and the diseases of animals and plants is enormous; and many of the methods of dealing with them—as with foot and mouth disease and swine fever—barbarous; if at present imperative.

Yet no one stirs, save to gyrate each in his own little circle. There is no integration, no organization of research, no cross light from school to school, no mutual enlightenment among investigators, no big outlook. The destruction by insects in forestry and agriculture alone in Great Britain is put at £30,000,000 per annum.[8] An Institute of Comparative Pathology in Cambridge with the endowment of professorial chairs and subordinate workers would cost no doubt a quarter of a million, a big sum; but what is this to the wastage of disease throughout the world of life!—to swine fever, diseases of cattle and horses, of crops, of forests, and so forth—utilitarian ends it is true, but to be followed on paths of discovery which would illuminate the whole field of nosology. Diseases are not "entities," nor even recurrent phases of independent events, but partial aspects of a universal series. The young graduates we have, many of them of great capacity; but every day we are losing them because they are not taken up at once into scientific teams; so they slacken, or drift into some other means of livelihood, and things muddle on as before. How blind we are!

T. Clifford Allbutt

[8] Mr. L. Scott, M.P., in the House of Commons.

THE RECENT EARTHQUAKES AT LOS ANGELES, CALIFORNIA

To the late Homer Hamlin more than any one else is due the credit for identifying the connection between certain local structural lines and the earthquakes which have affected the region about Los Angeles, Cal., during the past month. Hamlin's work, to the writer's knowledge, covered a period of over fifteen years prior to his death a few weeks ago. He, single handed, studied the cause of more than twenty earthquakes of varying degrees of intensity which have occurred in southern California during this period. Hamlin's conclusions, few of which unfortunately ever were put in print, were that the line of structural disturbance along which the epicentrums of most of the earthquakes were located, was that which extends from the Santa Monica Mountains, north of the Soldier's Home (about ten miles northwest of the business district of Los Angeles), in a southeasterly direction through the Baldwin Hills, Dominguez Hill, El Cerrito (near Long Beach), and thence easterly to the San Joaquin Hills northeast of Newport. The section along this line which has been the greatest offender is that extending several miles southeasterly from the Baldwin Hills. From a study of the intensity records, Hamlin was inclined to believe that the actual epicentrums were coincident in general with a fault which paralleled the anticline forming the Baldwin and Dominguez Hills, and extending along the northeast base of these hills. This may be true, but the writer is inclined to the theory that the actual crustal movements which produced the shocks took place along the Baldwin Hills-Dominguez Hill line, and that the maximum surface reaction might have been greater to the east of the hills because of the more unconsolidated character of the sediments in this direction.

In the shocks that occurred in the middle of June last, the greatest intensity was at Inglewood, a town lying ten miles southwest of Los Angeles, and only a very short distance southwest of the axis of the Baldwin Hills-Dominguez Hills fold. This would confirm the theory that the main line of disturbance is along the axis of this fold. In the shocks of July 16, the newspaper reports indicate only slight damage in Inglewood with the principal damage in the city of Los Angeles proper. These reports being true, it seems probable that this last tremor originated along the very pronounced fault, that extends east and west through the northwest residential district of Los Angeles, or along one of the lines of disturbance associated with this fault. It is this fault which marks the northern boundary of the oil-producing area of the Los Angeles city field, and is believed to act as a barrier to the northward migration of the oil in the sands on the down-thrown block of Pliocene sediments on the south side of the fault. This fault is part of a zone of disturbance which extends eastward past Whittier and is responsible for the structurally complex Puenta Hills north and west of Whittier. This last named town is mentioned in the dispatches as having been subjected to sharp shocks on July 16; further evidence of the probability of the cause of this earthquake being in the east-west line of disturbance just described. It would be natural to suppose that a readjustment of stresses along the Baldwin Hills-Dominguez Hills line in the earthquakes in June might develop stresses in the east-west line north of Los Angeles that relieved themselves by movements which caused the disturbances of July 16.

In connection with the earthquake history of the Los Angeles region, attention is called to the very recent earth movements that are recorded in the topography thereabouts. San Pedro Hill, over 1,000 feet in height, which marks the southwest corner of the Los Angeles Plain, has eleven wave cut terraces on its southern or ocean side, all of which are believed to be of Pleistocene age. Beds along the flanks of the Baldwin Hills-Dominguez Hills-El Cerrito fold, dipping over 30°, are known to be of Pleistocene age. Pleistocene fossils are found at a depth of over 1,000 feet in a well at Bells Station on the Los Angeles plain south of Los Angeles. At least

two different systems of terraces of Pleistocene age are found within the city of Los Angeles. Many other examples might be enumerated of evidences of the youth of the geologic and topographic features around Los Angeles, and along this part of the California coast in general.

Thus there are many reasons to expect frequent evidences of seismic activity in this region, but owing to the local character of most of the lines of structural weakness, extensive disturbances are not probable. The Great Earthquake Rift, or San Andreas Fault zone lies fully forty miles north of Los Angeles with several granite mountain ranges in between as buffers. Therefore the Los Angelenos may console themselves that they are not in the main earthquake belt.

Ralph Arnold

New York

AUGUSTO RIGHI

Often the death of a great personality in one of the fields of pure science is only felt directly by the small band of fellow workers in that field, while the passing away of one who has contributed but little original knowledge and has merely popularized the work of investigators makes a disproportionate impression on the general public, but in the death of Augusto Righi, professor of physics in the University of Bologna, and senator of the Kingdom of Italy, both the professional scientist and the amateur have suffered an irreparable loss. Righi combined in an inimitable way the ability to popularize the great central truths of his science with the genius of the born investigator. His published contributions in physical research cover the period of nearly fifty years and number nearly two hundred and fifty papers. Almost none of these papers are published in collaboration with other physicists, but represent his own individual work.

The present writer was privileged to spend part of one year as a guest in Righi's laboratory in Bologna. It was at the period when the first experiments of Sir J. J. Thomson and his pupils at Cambridge were providing the foundation for the beautiful structure of the electron theory which has since been reared. Righi had been carrying on investigations along lines which made him quick to seize the significance in his own problems of the work of the Cambridge School, and there was unmistakable evidence in his laboratory of great investigative activity—every evidence but for one fact: Righi never seemed to be working—he always seemed to have leisure to discuss other peoples' problems and to attend to the direction of the research of his numerous graduate students. Commenting on this one day to Righi the present writer learned that it was his custom to do all of his own investigative work in the three or four hours of the day before breakfast when he had his laboratory wholly to himself.

His treatment of his graduate students followed the German method rather than that which seems to characterize our own methods. He rarely published the results obtained in his laboratory jointly with the student but rather gave freely of his time and advice and let the student be the sole sponsor of his own work. A notable example of this is furnished in the well-known relation between Guglielmo Marconi and Augusto Righi—Righi, the friend and co-worker of Hertz and the teacher of Marconi, the pioneer in the adaptation of the epoch-making discovery of Hertz to telegraphy. Righi's friends appear to have been jealous lest he should fail to receive proper credit for his part in making wireless communication possible; but not so Righi himself, who cared little for popular applause and actually enjoyed a fuller measure of it in his own country than ordinarily falls to the lot of the pure scientist. His own attitude towards science is well expressed in his own words in an address before one of the many societies of which he was president.

> I refer to the pure science of physics, that science which does not occupy itself too much with matters of the practical application of its discoveries and does not trouble itself about the material advantages which may accrue to him who happens to make these discoveries, but above all else sets itself the task of establishing the great laws which govern the phenomena of the inanimate universe.

To this great task Righi devoted natural abilities singularly adapted to the needs of his science in the period of his greatest productive activity, when our views as to the nature of electricity and of matter were undergoing a fundamental reorganization.

Righi was a serious and well-trained thinker brought up in the old school and one who was too experienced to be led astray by brilliant generalizations which lacked sound experimental confirmatory evidence, and yet withal he possessed in some measure those gifts which we are most likely to associate with the poet or with women than we are with a man in an exact science—the gifts of imagination and intuition. That these two qualities were necessary in the building up of the electron theory nobody will deny. They are possessed by the living Thomson, Rutherford and a few of their co-workers and they were possessed by the dead Righi, and his name will stand with theirs in the history of his science.

AUGUSTUS TROWBRIDGE

SCIENTIFIC EVENTS

THE CENTENARY OF SIR JOSEPH BANKS

THE commemoration of the centenary of Sir Joseph Banks, Bart., who died on June 19, 1820, has been celebrated by the Linnean Society. According to the report in *Nature*, Dr. B. Daydon Jackson read the first communication on "Banks as a Traveller," speaking of his four overseas voyages—first, the visit to Newfoundland in H.M.S. *Niger*, on board which his friend Constantine Phipps, afterwards Lord Mulgrave, was a lieutenant; next, the adventurous voyage of the *Endeavour*, Lieutenant Cook commander, when Banks so amply proved his value in many untoward events; third, the voyage to Iceland; and fourth, his trip to Rotterdam in 1773, when he was still eager for an expedition to the north. The second paper, by Dr. A. B. Rendle, was entitled "Banks as a Patron of Science." Banks's life from his return to England in 1771 until its close in 1820 was that of an enthusiastic, liberal, and generally far-sighted patron of science. A friendship began with King George, which steadily increased, and Banks was consulted on important matters of very various kinds. He became botanical adviser to the King in relation to the Royal Gardens at Kew, which developed under Banks's guidance, becoming the repository of plants of economic and ornamental value from all parts of the world. Banks initiated or encouraged voyages of exploration, and kept up an extensive correspondence with men interested in science overseas. His house in Soho Square was the rendezvous of students and men of all classes interested in schemes of philanthropy or science; his magnificent library and herbarium were at the service of other workers, and after his death were bequeathed to the British Museum. For forty-two years he was president of the Royal Society. He was very closely, though indirectly, associated with the origin of the Linnean Society. Mr. James Britten, in the third paper, began by remarking that much of his paper was based upon the daily use of Banksian specimens for nearly half a century in the British Museum. The author showed that the popular belief that Banks left all his botanic work to his secretaries and curators, Solander and Dryander, was a mistaken one, and that Banks displayed great botanic acquirements. The president remarked that official records of the British Museum testified to the active interest taken by Banks in all matters connected with its advancement, and that keepers and trustees alike referred to him for his advice and decision. Certain objects closely connected with Banks were exhibited.

THE EPIDEMIC OF INFLUENZA IN ENGLAND

A FURTHER report on the great influenza epidemic has been issued by the Registrar-General. According to the abstract in the London *Times* the report states that the deaths allocated to influenza during 1918 numbered 112,-329, the males being 53,883 and the females 58,446. The males included 7,591 non-civilians, and, deducting these, the deaths of civilians corresponded to a mortality of 3,129 per 1,000,000 civilian population.

No such mortality as this has ever before been recorded for any epidemic in this country since registration commenced, except in the case of the cholera epidemic in 1849, when the mortality from that cause rose to 3,033 per 1,000,000 population. None of the previous outbreaks of influenza can compare in mortality with that of 1918–19. During the 46 weeks, June 23–May 10, the total deaths allocated to the disease were 151,446, including 140,989 of civilians, the corresponding civilian death-rate for these 46 weeks being at the annual rate of 4,774 per 1,000,000 population.

It is pointed out that the mortality attributed to influenza does not represent the whole of that caused by it. The entries under other headings, especially those of respiratory disease, were always bound to increase during an epidemic, and though that did not occur in 1918 to the same extent as in other recent outbreaks, allowance must be made for these increases in mortality, allocated to other causes but really attributable to influenza, in endeavoring to measure the loss of life caused by the epidemic.

With regard to the deaths of females, when pneumonia, bronchitis, heart disease and phthisis are included, the deaths attributable to the epidemic during the third quarter of 1918 were 7,741, and during the fourth quarter 62,240. The figures for males for the same quarters were 8,088 and 51,359, respectively.

In earlier years influenza was less important under 55 years and more so above that period. In 1918–19 this position was suddenly and violently reversed. Those under 35 died in appalling number; those over 55 seemed to be relatively safe. The report says:

It may be doubted whether so sudden and so complete a change of incidence can be paralleled in the history of any other disease, yet all the weight of medical testimony goes to show that the influenza of 1918 was essentially the same as that of former years. Attempts have been made to explain the change as due to alteration in the circumstances of the population. Thus it has been suggested that aggregation of young women in munition works in 1918 may partly account for their specially heavy mortality. No simple explanation on these lines is possible. The alteration in age incidence accompanying the increased prevalence and fatality of the disease in 1918 seems to be more easily explained by a sudden change in the infecting organism than in the soil provided for its growth.

THE ENFORCEMENT OF THE FOOD AND DRUG ACT[1]

During the last few years the people of the United States have been given a very material amount of protection against those swindlers who sophisticate the foodstuffs and drug supplies of the country. Especially good work has been done in obtaining convictions against "patent medicine" fakers who have made false and fraudulent claims for their nostrums. This protection has been given through the enforcement of the federal Food and Drugs Act. The administration of this law rests with the Department of Agriculture, which acting through its Bureau of chemistry, collects evidence and lays the groundwork for the legal machinery of the government to proceed against the offender. The activity of the Bureau of Chemistry of the Department of Agriculture has, of course, aroused the strongest antagonism on the part of the nostrum interests. These interests may well rejoice in the recent action of congress in cutting down the appropriations for the Department of Agriculture. Even under the appropriation given for the last fiscal year, which ended June 30, 1920, the department was greatly hampered in its work of enforcing the Food and Drugs Act. Under the plea of economy, Congress has reduced the appropriation for the enforcement of this act by thirty thousand dollars. The *Oil, Paint and Drug Reporter,* a highgrade and conservative publication, well states the fact, in commenting on this disgraceful condition of affairs, when it says:

Under the reduced amount provided for next year, it will be impossible to supervise the regulation of the Food and Drugs Act as it should be supervised. This portends a rich harvest for those who misbrand and adulterate medicinal, pharmaceutical, disinfectant and other preparations. The vast public, which daily purchases and consumes

[1] From the *Journal* of the American Medical Association.

these products, will be the chief sufferer. At a time when the act requires enforcement of the most rigorous nature the Congress has succeeded in hamstringing it.

At a time, then, when in all lines of industry the spirit of exploitation is rife, Congress, under the specious plea of economy, practically nullifies the protective power of one of the most useful pieces of federal legislation ever enacted.

ALASKA SURVEYS AND INVESTIGATIONS IN 1920

Under the appropriation of $75,000 made for the investigation of the mineral resources of Alaska, the Geological Survey has dispatched seven field parties. The work to be done is that of extending the surveys and investigations which were begun in 1898.

G. H. Canfield is continuing investigations of the water powers of southeastern Alaska in cooperation with the Forest Service. The water powers are important not only to mining but to the wood-pulp industry.

In July L. G. Westgate will make a geologic reconnaissance of the region adjacent to Hyder, on Portland Canal, where gold and silver bearing lodes have been found.

F. H. Moffit, geologist, with H. Insley as assistant and C. P. McKinley, topographic engineer, are making reconnaissance surveys on the west side of Cook Inlet between Iliamna Bay and Snug Harbor. Their special mission is to survey the Iniskin oil field.

J. R. Eakin is making topographic reconnaissance surveys in the headwater regions of Susitna River, in order to complete as soon as possible the mapping of the region tributary to the government railroad.

P. S. Smith is making a geologic reconnaissance of the placer districts tributary to Richardson, on Tanana River. This region has long been a producer of placer gold in a small way. Promising deposits of auriferous gravels have been reported in it during the last two years.

Alfred H. Brooks accompanied Secretary Payne to Alaska in July, the objective being the Alaska Railroad and the Matanuska coal field. Later Mr. Brooks, in company with Arthur E. Wells, metallurgist of the Bureau of Mines, will visit some of the copper-bearing districts of the Pacific seaboard of Alaska.

G. C. Martin is on the way to McGrath, on Kuskokwim River, to investigate the mineral resources in that vicinity. This district produces considerable placer gold and contains some promising gold-bearing lodes.

The geologic and topographic reconnaissance surveys of Seward Peninsula were completed some years ago, but a detailed study of its mineral deposits must still be made, and this study has been assigned to S. H. Cathcart. Mr. Cathcart began work at Nome about July 1 and will continue until the end of the field season.

SCIENTIFIC NOTES AND NEWS

At its commencement exercises Harvard University conferred its doctorate of laws on Professor Roscoe Pound, dean of the Harvard Law School, whom President Lowell characterized as "lawyer and botanist; judge, teacher and writer, protean in interest; vindicator of the expansive power of the common law, who has also taken all jurisprudence as his privince and mastered it." In conferring degrees of doctor of science President Lowell said: "William Williams Keen: a surgical officer in the Civil War, the Spanish War and the World War—a man whose career in his profession has been one of long and ever rising distinction; the dean of American surgery." "Hermann Michael Biggs: Pathologist and physician; guardian of the public health; who, by his combat with tuberculosis in New York, has rescued countless lives."

Colonel Richard P. Strong, of Harvard University, chief medical director of the League of Red Cross Societies, has been elected to honorary membership in the Serbian Medical Society as an expression of admiration for his scientific achievements, and as a mark of appreciation for the great sympathy which he showed to the Serbian people.

Dr. J. S. Flett, F.R.S., at present assistant to the director in Scotland, has been appointed

to be director of the British Geological Survey and Museum. Dr. Flett succeeds Sir Aubrey Strahan, who retires when Mr. G. W. Lamplugh, F.R.S., assistant to the director in England, also retires.

Mr. E. A. Milne, B.A., Trinity College, has been appointed assistant director of the Solar Physics Observatory, Cambridge.

The David Syme prize, with medal, for the year 1920, has been awarded to Mr. Frederick Chapman, paleontologist to the National Museum and lecturer in paleontology in the University of Melbourne.

The president of the French republic has conferred the honor of officer of the Legion of Honor on Dr. Aldo Castellani, of the London School of Tropical Medicine, for his method of combined typhoid-paratyphoid and typhoid-cholera vaccination.

The ninetieth birthday of John Jacob Bausch, of Rochester, founder of the Bausch and Lomb Optical Company, was celebrated on July 25.

We learn from the *Journal* of the American Medical Association that Professor Luigi Pagliani, of the chair of hygiene in the University of Turin, reaches the age limit this year, and it is also the fiftieth anniversary of his professional career. He was the pioneer in organizing the public health service in Italy, in directing legislation and in controlling and preventing epidemics. A committee consisting of the incumbents of all the chairs of hygiene in the country has been formed to collect funds to found an annual prize, the Pagliani prize.

Julius C. Jensen, of the Weather Bureau, has been appointed vice-consul at Copenhagen, Denmark, and has sailed from the United States.

Professor H. C. Little, of Colby College, has been appointed executive secretary to the Division of Geology and Geography of the National Research Council.

A laboratory for research on dyestuffs and explosives has been established at George Washington University. The laboratory which is under the general supervision of Professor H. C. McNeil, will be in charge of Mr. G. W. Phillips, formerly of the Chemical Warfare Service. Dr. C. E. Munroe, of the National Research Council, will be consulting chemist of the laboratory.

Dr. A. C. Trowbridge, professor of geology at the University of Iowa, has been offered a position with a New York Company to carry geological work in South America next year, but has declined and will remain at the state university. At present Professor Trowbridge is in Texas working for the United States geological survey.

Dr. Harvey Bassler, formerly paleontologist with the U. S. Geological Survey, is now engaged in exploratory work for the Standard Oil Company in South America.

Mr. R. M. Overbeck has returned from Bolivia and has resumed work in Alaska for the U. S. Geological Survey.

Dr. Jacob Sobel has been designated assistant director of the Bureau of Child Hygiene of the New York City Department of Health.

Dr. Helen MacMurchy, Toronto, has been appointed to take active charge of the division of child welfare in the federal department of health, Ottawa.

Dr. Harlan I. Smith, of the Canadian Geological Survey, has left Ottawa to carry on an archeological reconnaissance in the Bella Coola Valley of British Columbia.

Mr. Charles M. Hoy is collecting for the Smithsonian Institution in Australia.

Professor Warren D. Smith is taking a leave of absence for one year from the University of Oregon to go to the Philippines as chief of the Division of Mines of the Bureau of Science in order to rehabilitate the work of that department. En route to the Philippines he will attend the Pan-Pacific Scientific Congress in Honolulu, August 2–20, as delegate from the University of Oregon. He expects to return to the University of Oregon in October, 1921.

Roald Amundsen, the Norwegian explorer, arrived in Nome on July 28, having made the voyage from Norway through the waters north

of Europe and Asia. In 1906 Amundsen followed the northwest passage from the Atlantic to the Pacific around North America.

THE committee which plans to erect an Osler Institute of General Pathology and Preventive Medicine in Oxford to commemorate the distinguished services of Sir William Osler in Canada, in the United States and in England, is about to issue an appeal for funds. The general committee contains representatives of the universities of Aberdeen, Birmingham, Bristol, Cambridge, Durham, Edinburgh, Glasgow, Leeds, Liverpool, London, Oxford, Sheffield and Wales, and also of the Royal Colleges of Surgeons and Physicians, of the Faraday Society, of the British Association, and of the British Academy.

THE death is announced of Professor Alexander Supan, chief of the Geographical Institute of Breslau, in his seventy-third year.

THE death is announced of William Schallmayer, one of the best-known German students of eugenics.

ARTHUR J. ELLIS, geologist on the U. S. Geological Survey, died July 22, following an operation for appendicitis. A correspondent writes: "Born in Kansas January 6, 1885, he spent his boyhood in Illinois and in 1908 married Orrel Everett, who, with their daughter, survives him. He received the degrees of B.A. in 1908 and M.A. in 1911 from the University of Illinois. After an experience of several seasons on the Illinois Geological Survey, he was appointed to the U. S. Geological Survey in 1911 and was assigned to work on the Ground Water Division, in which he rose to the position of assistant chief. He is the author of reports on the ground waters of Connecticut, the geology and ground waters of San Diego county, California, and several unpublished manuscripts, a number of which are reports on water supplies for military purposes made during the war. His most widely read publication is a 'History of the Divining Rod.' The survey has lost a valuable member and the profession a young man whose painstaking work pointed to a useful future. His friends appreciate that they have known a rare spirit, which rose above the difficulties and sacrifices of a life devoted to science."

AT a recent Cambridge meeting of the British Medical Association it was decided to increase the annual subscription from two to three guineas. The reason for the increase was not only the great increase in the cost of producing the *Journal* in all directions, but also the need for adequate funds to carry on the forward policy of the association.

THE hospital installed by Brasilians in Vaugirard, France, at a cost of $2,000,000 has been offered by the government of Brazil to France and has been accepted by the Paris Faculty of Medicine.

IT is announced that the Swedish parliament has appropriated 50,000 crowns for the yearly maintenance of the Institute for the Study of Heredity at Upsala, of which Professor H. Lindborg is in charge.

A RESEARCH association for the cutlery industry has been approved by the British Department of Scientific and Industrial Research. The secretary of the committee engaged in the establishment of the association is Mr. W. H. Bolton, Sheffield.

THE Bureau of Mines has completed arrangements for a cooperative research on the carbonization of lignite. $200,000 is to be supplied by private parties for the erection of a plant at New Salem, North Dakota. The bureau will be in charge of the technical and experimental side of the investigation.

WE learn from *Nature* that the Marshall herbarium, comprising 23,000 sheets of British plants contained in dustproof oak cases, has been bequeathed to the university by the late Rev. E. S. Marshall.

BY the will of the late Dr. Rudolph Messel, the Royal Institution of London receives £5,000.

THE new library building of the Nantucket Maria Mitchell Association, opposite the Memorial House and Observatory, Nantucket, Mass., was dedicated on July 15. This is a scientific library free to all interested in astronomy or any of the natural sciences. It is

planned that the increased space for books will meet all demands of nature lovers. The library is open: 10 to 12 A.M. and 2 to 5 P.M., from June 15 to September 15 each year, and during the winter two afternoons of each week from 2 to 4

Geo. P. Gray has resigned his position as assistant professor of entomology and chemist, insecticide laboratory at the University of California to become chief of the division of chemistry of the State of California Department of Agriculture, with headquarters at Sacramento. The Department of Agriculture established at the last session of the California legislature was fostered by Governor Stephens as an economy and efficiency measure, and correlates under Director G. H. Hecke, several boards and commissions formerly charged with the enforcement of various laws pertaining to agriculture. The work of the department is organized into three divisions: Plant Industry, Animal Industry and Chemistry. The Division of Chemistry, under Professor Gray, is to handle the official analysis and testing of materials incidental to the administration of the state laws regulating the manufacture and sale of insecticides, fungicides, fertilizers and dairy products and the fruit and vegetable standardization laws.

It is stated in *Nature* that the British Medical Research Council has recently established at the Lister Institute of Preventive Medicine a national collection of type cultures from which biologists in general, and bacteriologists in particular, may obtain authenic strains of recognized bacteria and protozoa for use in scientific work. The scheme is under the general direction of Dr. J. C. G. Ledingham, while Dr. R. St. John Brooks has been appointed to the post of curator of the collection and Miss Mabel Rhodes to that of assistant curator. It is proposed to collect and maintain bacterial strains from all departments of bacteriology, human, veterinary and economic, and already considerable work has been done towards the formation of a representative collection on these lines. The efforts of the staff are, however, at present particularly directed towards the securing of fully authenticated strains responsible for or associated with disease in man and animals. The bureau proposes to supply cultures on demand to all workers at home and abroad, and, as a rule, a nominal charge per culture will be made to defray postage and media. Strains sent for identification and maintenance should be accompanied by particulars as to source, date of isolation, etc. In due course a catalogue will be prepared for publication.

UNIVERSITY AND EDUCATIONAL NEWS

A plan for securing within five years $10,000,000 to meet the urgent needs of the University of Chicago is now being carried out. For salary increases already made or authorized the sum of $4,000,000 as additional endowment is needed. The new plans involve also the formation of certain institutes within the graduate school for conducting such research and training in pure science as has an immediate bearing on the application of the sciences to industry. The institutes proposed are those of physics and chemistry, plant agriculture, mining and the science of education.

Professor O. M. Leland, formerly of Cornell University, but recently of the J. G. White Engineering Corporation, New York City, has been elected dean of the colleges of engineering, architecture and chemistry in the University of Minnesota. During the war, Professor Leland was lieutenant colonel of engineers in the 78 and 89 Divisions and saw active service in France and Germany. Up to a few months ago, he had been a member of the Cornell faculty since 1903.

Dr. O. E. Jennings, curator of botany at the Carnegie Museum and for several years in charge of the work in botany at the University of Pittsburgh, has been given the rank of professor of botany at the latter institution.

Dr. Claude S. McGinnis has joined the faculty of Temple University, Philadelphia, as professor in the department of physics. Dr.

McGinnis has been for nine years professor of physics and electrical engineering in the University of New Brunswick, Fredericton, N. B.

DR. HARRY B. YOCOM, of the department of biology of the College of the City of New York, has been appointed assistant professor of zoology in the University of Oregon.

DR. F. FRANCIS, professor of chemistry, has been appointed pro-vice-chancellor of Bristol University, in succession to Professor C. Lloyd Morgan, who is about to resign office. Dr. Lloyd Morgan has been appointed emeritus professor of psychology and ethics.

DISCUSSION AND CORRESPONDENCE

A PRIORI USE OF THE GAUSSIAN LAW

TO THE EDITOR OF SCIENCE: Mr. Michael[1] in interpreting Dr. Johnstone's results[2] for twenty counts of bacteria in polluted shellfish deplores certain naive errors to which the lay statistician is prone, but is not, so it seems to me, free from statistical illusion himself. I had hoped, at least, that the identification of the Gaussian law with the ideal "chance" distribution was a custom of the past, and that the prevalence of this practise in the literature was simply due to the inertia of thinking. May I submit the following relevant observations?

1. The sole condition of "change" is ignorance.[3] In science the thing to do with ignorance is to admit it, not to posit the form of distribution that a variable assumes under it.

2. Biological and mental phenomena, of whose conditions of variability we are thus ignorant, do not necessarily give symmetrical distributions when observed. Pearl showed that the amount and direction of skewness and the dependence of skewness on known conditions might be the significant biological fact.[4] The Gaussian law does hold for coin-tossing, but the relationship has been scientifically observed,[5] not posited a priori.

3. Moreover, there can be no reason to expect a Gaussian distribution a priori when we are ignorant. A form of distribution is always function of the unit of measurement; and, since the choice of a biological unit is ordinarily arbitrary, the chances of getting the normal distribution are very small.[6] Galton pointed out, furthermore, that chance distributions of two related variables, when the relationship is not linear, can not both be Gaussian.[7]

4. When we observe a skew distribution and are in ignorance of the conditions that cause the variation, it is useless labor to factor the skew distribution into a Gaussian "chance" distribution and a skewing factor, as Mr. Michael does. The two factors that we so obtain are meaningless. The Gaussian function is biologically meaningless because there is neither a priori nor observational ground for taking it as the curve of chance (ignorance). Mr. Michael's logarithmic function is biologically meaningless because it is merely a measure of the manner in which the observed data depart from the meaningless Gaussian law. Pearson saw this point in 1900 and noted the fallacy.[8] He also made fun of the Gaussian "fetish," although the position of the Biometric School has since become less definite.

5. Probability in science means frequency and nothing more. Fundamentally in science

[1] E. L. Michael, "Concerning Application of the Probable Error in Cases of Extremely Asymmetrical Frequency Curves," SCIENCE, N. S., 51, 89–91.

[2] J. Johnstone, "The Probable Error of a Bacteriological Analysis," cited as Rept. Lanc. Sea-Fish. Lab., No. 27, 1919, 64–85.

[3] *Cf.* J. Venn, "Logic of Chance," 1888, espec. 119 ff.; B. Bosanquet, "Logic," 1911, I., 322 ff. If the scientist prefers not to go to the logician, let him see if he can formulate for himself, with scientific rigor, the conditions of "chance."

[4] R. Pearl, "Variation and Differentiation in *Ceratophyllum*," 1907, espec. 90 f.

[5] *E. g.*, see H. Westergaard, "Grundzüge der Theorie der Statistik," 1890, 21–38.

[6] J. Bertrand, "Calcul des probabilités," 1889, 180 f.

[7] F. Galton, *Proc. Roy. Soc.*, 29, 1879, 365–367.

[8] K. Pearson, *Philos. Mag.*, 5th ser., 50, 1900, 173.

it means observed frequency. The value of the statistical constants is simply that they provide a conventional method of summarizing frequencies of observed data. To shift the meaning of probability from observed frequency to predicted frequency is precarious, although we are always attempting it in scientific generalization. However, it takes more than a process of division by the square root of the number of cases—the obtaining of the probable error of the mean—to bridge the gulf between observation and prediction. The lay conviction that the probable error of the mean is actually a prophecy is hard to overcome. That it is not prophetic will become clear to any one who will take the trouble to fractionate a large body of data, compute the probable errors of the means of each fraction and note how they vary, and then compare all these discordant predictions with the actual probable error of the means computed from the array of means. The probable error of the mean is a useful constant since it summarizes the variability of data in relation to their amount; but it is not a key to the future.

All this is negative. Actually what was Dr. Johnstone to do? First, observe and report, I should say; and let him predict who will. Certainly there is no need for much statistics to summarize his twenty cases. He wishes to know the most probable number of bacteria per cc. in this emulsion. Scientifically by the most probable number is meant the most frequent number; and his data show that 6–10 counts were more frequent than any other. Why obscure the simple fact by a statistical superstructure? If now he wishes to risk prediction on the basis of 20 cases, he may say that 6–10 counts will occur more often in his 250 c.c. than any other group, 16–20 counts next most often, 11–15 and 21–25 counts less often, and so on. This course has the simple merit of telling the observed truth and doing very little more.

In predicting the total number of bacteria within the 250 c.c. one must multiply the arithmetic mean of the counts by 250. We have given the distribution of 20 counts and we have no alternative to assuming that it is the most probable distribution of 20 counts. Hence we must take the observed distribution as many times over ($12\frac{1}{2}$ times) as 20 will go into 250 and sum all the frequencies. Dr. Johnstone found 366 bacteria in 20 c.c. The most probable number in 250 c.c. must be $250/20 \times 366 = 4{,}575$. Mr. Michael gets 4,005 by the erroneous assumption that the most probable (most frequent) logarithm is the logarithm of the most probable (most frequent) count, which is plainly impossible since the logarithmic relation is not linear. The illusion arises because we take it for granted that any most probable natural number must be inseparably connected with the most probable logarithm. When we substitute the word "frequent" for "probable" we may see our mistake, for the logarithms of the small numbers are more frequent than the logarithms of the large numbers.[9]

Concerning the general problem of obtaining "the probable error of extremely asymmetrical frequency curves," I would urge that in simple cases it is unnecessary to depart far from the observed facts. Usually one is most interested in the value of the most frequent (most probable) case and in the amount of deviation on either side. The values of the mode and of the upper and lower quartiles give this information, as well as the range within which half the cases have fallen and an indication of the skewness. Except the gift of prophecy, what more could one want?[10]

EDWIN G. BORING

CLARK UNIVERSITY,
WORCESTER, MASS.

ALBINO VERTEBRATES

IN July 1919, on the Beaver River near the mouth of the Dore River in Saskatchewan, I shot a pure albino grackle (*Quiscalus quiscula æneus*). It was a young male, 10.5 inches long, and was associated with a flock of grackles. It seemed much less shy than the

9 S. Newcomb, *Amer. J. Math.*, 4, 1881, 39 f.

10 See in general, "The Logic of the Normal Law of Error in Mental Measurement," *Amer. J. Psychol.*, 31, 1920, 1.

rest of the flock. I have sent the damaged skin to the Provincial Museum at Regina.

In the summer of 1915, two living albino specimens of Richardson's spermophile (*Citellus richardsoni*) were sent to this university from near Hanley, Sask. I saw them, but through carelessness they were both lost before further data were obtained.

An albinistic crow of a very light brown shade is among the stuffed birds of the university collection. Beyond the fact that it was taken in Saskatchewan, I have been unable to learn anything about it.

John S. Dexter
University of Saskatchewan

A PLEA FOR MORE EXPLICIT DESIGNATION OF SCIENTIFIC REPRINTS

The library of the Bureau of Fisheries contains one of the largest, if not the largest, collection of reprints on the subject of aquatic biology. It is the practise of the bureau to make analytical cards of all such separates, copy being furnished the Library of Congress by which the cards are printed. These cards become part of the Library of Congress issue and have world-wide distribution.

That the cards may be used with confidence by those needing them for bibliographical purposes and unable to consult the volumes in which they have appeared, it is necessary that the cards not only show the source of the reprints but also give the place of publication, date, volume, and pagination. Unfortunately separates are frequently devoid of such data. It is astonishing indeed that a great number of reprints are found to be without indication of the year of publication; many give no reference to the journal from which they are reprinted; and nearly all lack mention of the place of publication. Frequently the publication in which the article originally appeared is not available; but even when it is at hand the librarian has no right arbitrarily to give the place of publication of the original as that of the reprint, unless the reprint so states. Difficulty is frequently encountered with reprints which carry only a caption title and bear no date of issue; in such cases, it may be possible to give the date which appears on the title page of the volume (provided the volume is available) but frequently the issue of the volume is antedated by the separate. The date of first publication is of paramount importance in certain instances, as every investigator knows.

The Bureau of Fisheries has endeavored to establish a standard of high efficiency in the bibliographies attached to its publications, and publishes none submitted until they have been fully verified. If all reprints consulted by authors compiled with the simple and obvious requirements of bibliographical reference, much labor would be saved and greater accuracy assured. Under present conditions much time is frequently required, to locate original papers and, failing in this, it is sometimes necessary to return bibliographies to the investigators, only to find that, in some cases, they have seen only the separates and can not therefore authoritatively supply the necessary data.

It is of course of vital interest to investigators that their papers be cited correctly and it is therefore important that every author see to it that his reprints indicate not only the source, but also place, date, volume and pagination. This end could readily be accomplished with the cooperation of editors and publishers of scientific journals, proceedings and transactions of scientific societies, and state and institutional reports and bulletins. The slight additional labor involved would be fully justified by the saving of time and worry of other investigators, librarians and editors, and by the prevention of confusing errors of citation.

Rose M. MacDonald
Librarian, U. S. Bureau of Fisheries,
Washington, D. C.

SCIENTIFIC BOOKS

Report of the Second Norwegian Arctic Expedition in the "Fram," 1898–1902, 4 volumes in 36 parts, large octavo, 1907–1919, 9 maps, 111 plates, and 2,071 pages of text. Published by the Society of Arts and Sciences of Kristiania (Videnskabs-Selskabet i Kristiania), at the expense of the Fridtjof

Nansen Fund for the Advancement of Science.

During the first Norwegian Arctic expedition, when the attaining of the North Pole by Nansen was the main object, Captain Otto Sverdrup expressed the desire to return to Arctic lands for exploration and mapping of portions of the American Arctic island archipelago. The fulfilment of this desire was made possible through gifts of about $60,000 by Consul Axel Heiberg and the Ringnes brothers, brewers in the city of Kristiania, the same three men whose generosity made possible the first Arctic expedition in the *Fram*. This staunch vessel, repaired and ready for a second time to pass through the ordeal of ice-bound seas, was the Storthing's contribution to the expedition. A more productive exploration of Arctic lands, with so small a sum of money, has not been made before, and the names of the donors are now permanently fixed in geography in the new islands, Axel Heiberg Land, Amund Ringnes Land and Ellef Ringnes Land. The expedition explored and mapped about 100,000 square miles, the greater part of which is new territory. Like most Arctic explorations, its successes were won through the hardest kind of work, and two lives were sacrificed to the advance of knowledge, those of the physician, Johan Svendsen, and the sailor, Ove Braskerud.

Captain Sverdrup was assisted in his work by fifteen men. Of these G. I. Isachsen was the cartographer, H. G. Simmons the botanist, Edvard Bay the zoologist, and Per Schei the geologist. A better fitted and a more loyal band of hard workers—both men of science and sailors—never explored unknown lands. They brought back the results and collections which are in the main described, either in English or German, in these four handsome volumes. It is a source of regret that Per Schei did not live to see the final working up of his grand geologic collections, since all attest that this warm-hearted man of science collected a vast mass of material; in fact, it may be said of him that he made accessible to paleontology and stratigraphy more information of an exact nature than all previous Arctic expeditions.

These four volumes, together with Captain Sverdrup's popular account, entitled "New Land" (2 volumes, 1904), should be in every scientific library, not only because of their great intrinsic value, but because we owe it to our Norwegian friends thus to show our appreciation of their splendid achievement.

The astronomical and geodetical observations are described by Isachsen (141 pages) and pictured on three large, topographically shaded maps, one of the most important results of the expedition. Terrestrial magnetism is treated by A. S. Steen (82 pages); the results here are important because the Sverdrup expedition worked for four years not far from the magnetic north pole. However, due to the lack of proper instruments and to other causes, the hoped-for results were not fully attained. The section on meteorology is by H. Mohn (399 pages) and consists of the facts gathered by the expedition, here detailed in tables presenting the atmospheric pressure, temperature of the air, humidity, winds, clouds, and precipitation.

All naturalists traveling in the far north are surprised by the extraordinary abundance of plants that come to life and bloom during the very short but extremely active growing season. Flowers may be gathered early in June, and for a month during June and July the plants grow day and night, because of the nightless days, and beautiful flowers of Alpine kinds may be collected within a few feet of the ice fields. There are no trees, and but few plants attain a foot in height, and yet in spots there is a green covering. Most of the plants grow in tufts and peripherally in small and large mounds. The entire growing season is less than four months long and yet during this time is made the necessary food on which the land animals subsist. Of these latter there are at least 30 kinds of insects, 7 spiders, 5 birds, and 9 mammals (polar bear, wolf, fox, ermine, glutton, lemming, hare, muskox, and reindeer). The two last named are large animals, and one wonders where they get sufficient food during the long winter.

The plant material gathered by Simmons amounts to over 50,000 specimens and is described in eight papers, though the marine algæ are not treated here. These results are a monument to the botanist's industry. Of fungi, E. Rostrup determines 80 forms. The lichens, in more than 7,000 specimens, are described by O. V. Darbishire, who states that they form the best collection ever made from the American Arctic. He describes 161 forms, and adds that about 253 lichens are now known from the region explored by the *Fram*. Among them is the food for reindeer and muskox. Of mosses, N. Bryhn describes 290 forms, of which 49 are new. The vascular plants (about 190 species) are determined by Simmons in three papers. Ellesmere Land alone has at least 115 flowering plants, and while in general this flora is a continuation of that of Greenland, yet there is a strong American trait (about 25 per cent.) that has come from the west. Curiously, the flora is most abundant on granite lands, richest on bird grounds and around Eskimo habitations, and least developed on Paleozoic limestone. An abundance of ground-water here as elsewhere is a first necessity.

The Eskimo and Arctic travelers are always interested in the stranded drift logs in these treeless lands, since at times and places driftwood is common. Where does it come from? In some places good logs have been seen at elevations of about 300 feet above the sea. The Eskimo make their sledges, boats, and spears of them, since these cooled climates wood does not decompose and will remain intact indefinitely. The naturalist, however, is interested in their source. The *Fram* expedition collected 40 samples and these have been determined by F. Ingvarson, who tells us that there are three main sources for this wood, first, from the great Yenisei and Lena rivers of Siberia, second, from the St. Lawrence river, and finally, from the coast of Norway. Their distribution is brought about by the polar current drifting the Siberian woods, some across the north pole and others westward toward the east coast of Greenland, thence south and again north along the west coast of that country. The wood of the St. Lawrence is caught up by the Gulf Stream and drifted against Norway, where it gets mixed with Norwegian logs and both are borne westward against Greenland and so eventually attain Davis strait as far north as 62° 25′. In this way 31 species of forest trees may have attained the American Arctic archipelago (5 species of Siberian conifers and 6 of dicotyledons; 2 of Norwegian conifers and 9 of dicotyledons; and of American woods, 4 conifers and 5 dicotyledons). As conifers are most common in northern forests and float the longest, the dicotyledons soon becoming water-logged, they are the woods commonly met with in high Arctic regions.

In the summer time, Arctic waters are alive with migrant water birds, at least 18 species of which are here recorded. In this region they rear their young, and this means that the waters must be alive with animal food, a fact further attested by the former abundance of great migrant whales, and the presence of 5 species of native seals and of the walrus. The seals feed on fish and the walrus on molluscs, but the remainder subsist in the main on Crustacea. Of the latter, G. O. Sars describes no less than 154 kinds, among which the copepods (71 forms), amphipods (38), isopods (11), and ostracods (11) make up the bulk of the swimming invertebrate life. Back of all this animal life, however, there must be an abundance of plant life. Seaweeds are common enough below low-water mark, but the bulk of animal subsistence must be sought here, as elsewhere, in the phytoplankton, described in these reports by H. H. Gran. This author, however, states that the collections were wholly inadequate, and from the high seas, and that the actual Arctic phytoplankton was collected at but one place during middle August. J. A. Grieg describes 53 species of Mollusca and one of brachiopods, all from less than 150 feet of water. Of bottom-living Foraminifera, H. Kiær lists about 50 forms; and O. Nordgaard identifies 77 species of bryozoans, all of which are very different from those of Antarctic

waters. The Echinodermata, described by Grieg, include 2 crinids, 6 starfish, 6 ophiurids, strangely only 1 sea urchin, and 4 holothurians. The rest of the described marine fauna consists of 2 sponges, 4 actinians, 6 sea-squirts, 10 hydrids, 4 medusæ, and 44 kinds of polychæte worms. Clearly Arctic waters do not teem with a variety of animal life, but they make up for this in abundance of individuals.

The geologic results of Per Schei are very rich, not only in the abundance and variety of fossils gathered, but also in the record of the distribution of the various formations. Over the Archeozoic granites of Ellesmere Land lie about 14,000 feet of Paleozoic strata, beginning with Upper Cambrian, followed by basal Ordovician (Beekmantown), middle Ordovician, early and middle Silurian, and an extraordinary development of Devonian, having a thickness of about 6,000 feet (marine Lower and early Middle Devonian and an Upper Devonian fresh-water facies). The Carboniferous is known only in highest Pennsylvanian rocks, followed by marine Upper Triassic. Then there is no sedimentary record of any kind until the deposition of the Miocene fresh-water beds with lignites. As Per Schei died soon after the return of the expedition, the fossils are described by O. Holtedahl in three papers, one of which gives a summary of the geological results attained. The land plants of the Upper Devonian and the very few from the Miocene are described by A. G. Nathorst; the Devonian fishes by J. Kiær; the Devonian invertebrates by O. E. Meyer and S. Loewe; the Upper Carboniferous fauna by T. Tschernyschew and P. Stepanow; and the Triassic marine invertebrates by E. Kittl.

From Per Schei's account and the splendid photographs (the best Arctic pictures anywhere), it is evident that Ellesmere Land is an elevated and dissected table land, rising directly toward Greenland. Elevated strandlines and wave-cut terraces are seen along most shores, and are of various altitudes up to 570 feet. On one at 300 feet lie undecomposed driftwood and logs, attesting the recentness of some of this elevation.

Norsemen are still lovers of heroic work, and the north lands are their special scientific field. From them we are learning the geography, geology, and biology of the lands of the midnight sun on either side of Greenland, the territory of the Danes. We need, however, still more information about these almost inaccessible places, and let us hope that the Norwegians will soon extend their endeavors and modernize our knowledge of Nova Zembla.

CHARLES SCHUCHERT

SPECIAL ARTICLES

COMPUTING AGES OF ANIMALS

In the various experiments on animals in regard to growth, nutrition, activity, reproduction, etc., it is necessary to determine the age of the individuals at various times in their lives. These computations, involving mere additions and subtractions, take a great deal of the experimenter's time. The task is monotonous and soon becomes a matter of great drudgery.

Having before me the task of making several thousand such computations I sought a means of obtaining this data in a quicker and less tedious manner. The instrument described and used by Minot in his work on the guinea pig appealed to me. It had, however, the objectionable feature that the age of but one animal could be ascertained at a time. As I was dealing with a pair of animals whose weights were made on the same day and whose ages were to be determined when litters were born it was necessary to devise a scheme whereby the ages of two individuals born on different days could be readily determined at various times in their lives.

The device finally hit upon is so simple to make and operate that I have deemed it worthy of a description in order that others who may be wrestling with such tedious computations may be relieved of their drudgery.

The device consists of three meter sticks, *M*, *A*, and *F*, with two guides, *G*, *G*. The middle meter stick and the two guides are fastened securely to a board and the other two meter sticks slide freely. To facilitate

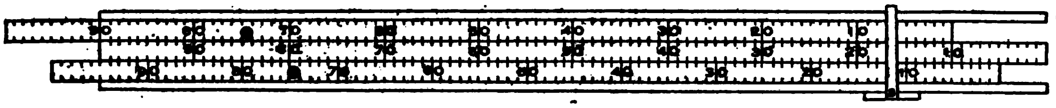


FIG. 1.

movement a small knob, *K*, is screwed to each of the movable sticks. A slider, *S* is made like a small T-square. It crosses the sticks at a right angle and can be moved freely along them. The two guides are slightly thicker than the meter sticks so that the movement of the slider does not change the position of the movable meter sticks. *M* is used in determining the age of the male and *F* that of the female. For the sake of simplicity the millimeters are not shown in the figure.

The method of using this device is best illustrated by an example. Suppose the male of a pair was born on April 10, 1919, and the female on February 19, 1919. The first date is the 100th day of the year, and the second date is the 50th day. A calendar having all the months of the year on one page and also having each day in the year numbered consecutively from both the beginning and the end of the year is used for determining what day in the year a certain date represents. Stick *M* is moved until its right end is even with the 100-millimeter mark on *A* and *F* is similarly moved to the 50-millimeter mark. If a weighing were made on June 9, 1919, which is the 160th day of the year, the slider is moved to the 160-millimeter mark on *A*. The age in days of each animal is now indicated on their respective sticks by the number of millimeters to the right of the slider. That is, the male is 60 days old and the female 110. If the age is to be computed on November 27, 1919, the 331st day of the year, the slider is moved to 331 on *A* and the age of each at once read off, which is 231 and 281 days respectively. The ages at any date in 1919 can thus be computed without moving anything but the slider.

If a date occurs in the succeeding year, 1920, then the sticks would require resetting. This is done in the following manner. The slider is moved to the 365 mark on *A*, which represents the last day of 1919, and the readings taken on *M* and *F*. These are 265 and 315 respectively, that is, the ages on December 31. These two numbers may also be found on the calendar since they are the days in the year when numbered consecutively from December 31 to January 1 corresponding to the two dates of birth. *M* is now moved to the right until its 265 millimeter mark is even with the end of *A* and *F* is moved in a similar manner until its 315 mark is even. This arranges the instrument for any date in 1920. If the ages are desired on March 28, 1920, the 87th day of the year, the slider is moved to 87 on *A* and the ages of the two animals are at once indicated as 352 and 402 days respectively. In this manner the ages may be rapidly determined for any date desired. It is obvious also that the device can be arranged to give the ages when the two animals are born in different years.

The limit of capacity of this device is 1,000 days. But in dealing with animals with a longer span of life each millimeter can represent a week, a month, or a year and the ages computed in these periods of time.

The excuse for this article is the hope that it may help some one who is confronted with a series of tedious computations similar to the ones with which I have had to contend.

J. ROLLIN SLONAKER

PHYSIOLOGY DEPARTMENT,
STANFORD UNIVERSITY

THE CLASSIFICATION OF THE OPALINIDÆ

I HAVE completed a study of one hundred and thirty-four species and twenty subspecies which according to the prevalent usage would be included in the genus *Opalina*. Twenty-four species were known before. My material, obtained mostly from the United States Na-

tional Museum through the great kindness of Dr. Leonhard Stejneger, is thoroughly representative for the whole western hemisphere and includes many forms from all other parts of the world, Africa, Europe, temperate Asia, the East Indies and Australia being well represented. Southern Asia is the only region from which there is but little material. Clear presentation of the taxonomic conditions shown in the rather large amount of data necessitates a more elaborate classification of the Opalinidæ than that generally in use. In the year 1918 I published a classification of the Opalinidæ. The completed review of all the material shows that this classification, if elaborated somewhat will be a clearer expression of the real facts. I therefore now propose the following classification:

- Ciliata
  - Protociliata
    - Opalinidæ
      - Protoopalininæ
        - *Protoopalina*
        - *Zelleriella,* new genus
      - Opalininæ
        - *Cepedea,* new genus
        - *Opalina*
          - *Opalinæ angustæ* (*occidentales*)
          - *Opalinæ latæ* (*orientales*)
  - Euciliata

The Opalinidæ are placed as an appendage of the Ciliata, being separated from the other Ciliata by the fact that they have not developed macronuclei and micronuclei, and by some features of their life history. They show, both in their structure and possibly in their life history, decided indication of relationship to the Trichonymphidæ which are usually regarded as an appendage of the Flagellata.

From the Opalinidæ I exclude all the genera of Ciliata astomata, which have nuclei of two sorts, leaving, only those forms which, with the exception of my own recent usage, have been included in the genus *Opalina*. The Opalinidæ include both binucleated and multinucleated species and these should be assigned to distinct subfamilies.

The Protoopalininæ include the genera *Protoopalina* (cylindrical binucleated forms) and *Zelleriella*[1] (flattened binucleated forms). The Opalininæ also include two genera, *Cepedea*[2] (cylindrical multinucleated species) and *Opalina* (flattened multinucleated species). The latter genus includes two groups of species—the western hemisphere forms, which are for the most part narrow, especially posteriorly, and the eastern hemisphere species, all of which are broad. All the other Ciliata may be classed as Euciliata in distinction from the Protociliata which include only the Opalinidæ.

There are two species which do not accurately fit into this classification as defined. They are *Protoopalina quadrinucleata* from *Rana macrodon* of Java and *Protoopalina axonucleata* from *Bufo bufo asiaticus* of eastern Asia. These species will be described in a paper soon to go to press. They are mentioned here merely because the former usually has four nuclei and the latter usually shows six to twelve nuclei. They are transitional forms between the genera *Protoopalina* and *Cepedea,* but are classed with the former genus because of the histological character of their nuclei which resembles that of the *Protoopalina* nucleus.

Maynard M. Metcalf
The Orchard Laboratory,
Oberlin, Ohio,
May 20, 1920

THE OHIO ACADEMY OF SCIENCE

The thirtieth annual meeting of the Ohio Academy of Science was held at the Ohio State University, Columbus, May 14 and 15, 1920, under the presidency of Professor F. C. Blake. Sixty-nine members were registered as present; thirty new members were elected.

The executive committee reported the completion of the affiliation of the academy with the American Association for the Advancement of Science in accordance with the plan adopted by the association at the Christmas meeting.

[1] Named for Ernest Zeller who in the year 1877 published a fine paper upon the European species of the family.

[2] Named for Cassimer Cepede whose studies upon Ciliata astomata clearly showed that the Opalinidæ are to be regarded as quite distinct from the other astomatous forms.

It was reported by the trustees of the Research Fund that Mr. Emerson McMillin, of New York City, had made a further contribution of two hundred and fifty dollars to the research fund. In view of his continued financial support of the research work of the academy Mr. McMillin was elected a patron; he was also elected to fellowship in the academy on the strength of his own contributions to science.

The following special resolutions were adopted by the academy:

1. Recording appreciation of the work of the Ohio Biological Survey and expressing the hope that its work, now financially crippled, may be continued with increased support.

2. Urging the utmost watchfulness in the conservation of platinum and condemning its use "in jewelry and in any other way that is not productive of scientific or industrial advance or development."

3. Urging a like conservation of potassium and the use, wherever practicable, of sodium salts as a substitute for potassium salts in scientific and commercial work.

4. Endorsing the work of the State Department of Agriculture in establishing preserves for game and other wild life of the state, and appointing a committee to cooperate in this work. This committee, under the chairmanship of Professor Herbert Osborn, of Ohio State University, is in position to cooperate also in the nation-wide movement in this direction instituted by the Ecological Society of America and endorsed by the American Association for the Advancement of Science.

Officers were elected as follows: *President*, W. H. Alexander, Weather Bureau, Columbus; *Vice-presidents:* Zoology, F. H. Krecker, Ohio State University; Botany, C. H. Otis, Western Reserve University; Geology, W. H. Bucher, University of Cincinnati; Physics, D. C. Miller, Case School of Applied Science; Medical Sciences, Ernest Scott, Ohio State University; Psychology, H. A. Aikins, Western Reserve University; *Secretary*, E. L. Rice, Ohio Wesleyan University; *Treasurer*, A. E. Waller, Ohio State University.

The scientific program was as follows:

PRESIDENTIAL ADDRESS

The Einstein theory of relativity and gravitation: PROFESSOR F. C. BLAKE, Ohio State University.

PUBLIC LECTURE

Photographing sound waves from large guns and projectiles: PROFESSOR DAYTON C. MILLER, Case School of Applied Science.

SYMPOSIUM BEFORE PHYSICS SECTION

The constitution of the atom: (*a*) *The planetary atom of the physicist:* S. J. M. ALLEN; (*b*) *Why not one kind of atom only?* R. C. GOWDY; (*c*) Discussion led by W. L. EVANS.

PAPERS

The Arizona boll weevil (*Anthonomus grandis var. thurberia*) *with special reference to steps taken by the Arizona Commission of Agriculture and Horticulture to prevent its establishment in cultivated cotton:* DON C. MOTE.

Aphelopus theliae (*Gahan*) *and the changes produced in Thelia by this parasite:* S. I. KORNHAUSER.

The intestinal parasites of overseas troops as compared with home service troops: S. I. KORNHAUSER.

A new disease, black tumor, of the catfish: R. C. OSBURN.

Classification of the Opalinidae: MAYNARD M. METCALF.

Geographical distribution of the Opalinidae: MAYNARD M. METCALF.

Factors in the distribution of aquatic snails in Lake Erie: F. H. KRECKER.

Caddis-fly larvae as agents in distribution of fresh water sponges: F. H. KRECKER.

Notes on some tropical Homoptera: HERBERT OSBORN.

Generic and specific characters from the male genitalia of Syrphidae (*Diptera*): C. L. METCALF.

Some myriapods of Put-in-Bay: STEPHEN R. WILLIAMS.

Claws of arachnids: W. M. BARROWS.

The chondrocranium of Syngnathus fuscus: J. E. KINDRED.

Additions to the birds of Ohio: LYNDS JONES.

Bird migration groups: LYNDS JONES.

Two recently destructive clover insects of western Ohio: T. H. PARKS.

The preservation of native flora and fauna: HERBERT OSBORN.

New economic applications for the mangrove: H. H. M. BOWMAN.

The progress of revegetation in the Katmai district: ROBERT F. GRIGGS.

Observations on the edge of the forest in the Katmai district: ROBERT F. GRIGGS.

The influence of environment on sexual expression in the hemp: J. H. SCHAFFNER.

A double mutant of the hemp: J. H. SCHAFFNER.

Translocation and storage of carbohydrates in apple fruit spurs and two-year-old seedlings: SWARNA KUMER MITRA.

Origin and character of schizogenous resin cavities in avocado fruits and leaves: Swarna Kumer Mitra.

Origin and character of adventitious roots in Cornus pubescence: Swarna Kumer Mitra.

Story of citrus fruits of Pinellas County, Florida: Katharine Dooris Sharp.

Factors controlling transpiration: Jasper D. Sayre.

Certain conditions that hinder the study of botany in high schools: Maximilian Braam.

Progress in plant microchemistry: H. C. Sampson.

Sugar syrup from home grown sugar beets: James R. Withrow.

Some farm experiments in the making of syrup from sugar beets: F. C. Vilbrandt.

Some pertinent questions for Ohio scientists: (a) Sulphuric acid and kiln plants and their fumes; (b) The errors of Ohio's legal kerosene flash point apparatus—the Foster cup; (c) The unnecessary use of potassium salts; (d) The damage to science and industry by the wastage of platinum: James R. Withrow.

Partial solution of certain applied chemical problems: (a) Saving of platinum by the use of platinum crucibles in electroanalysis; (b) By a modified mercury cathode cell; (c) The determination of water in substances easily decomposable thermally: James R. Withrow.

Gas combustion investigations: (a) Quartz-apparatus; (b) Central burner type; (c) Devitrification of quartz in capillaries: F. C. Vilbrandt.

The thermionic tube as a useful amplifying tool of the scientist: A. D. Cole.

A seasonal breakage of watch springs and its cause: Samuel R. Williams.

Springs of minimum weight: H. C. Lord.

Relations between atomic numbers and the wave lengths of X-rays: S. J. M. Allen.

Relations between absorption coefficients and wave lengths of X-rays: S. J. M. Allen.

Characteristic curves of different types of thermionic tubes: A. D. Cole.

Thermodynamics: Louis T. More.

Electrification by impact: Harold Richards.

On self and mutual elastance and capacitance: F. C. Blake.

Note on a double solenoid for the production of uniform magnetic fields: S. J. Barnett.

Observations on eruptive phenomena in the Valley of Ten Thousand Smokes: Robert F. Griggs.

Diastrophism still continuing in the Great Lakes region: E. L. Moseley.

Clarion and Vanport members in Ohio: Wilber Stout.

A pre-somite human embryo: C. L. Turner.

Relation of catalase to activity: R. J. Seymour.

Some features of industrial fatigue: E. R. Hayhurst.

Epidemic encephalitis: Ernest Scott.

Measurement of blood pressure by resistance of carbon discs: E. P. Durrant.

Educative characteristics of first grade children: Mary E. Miller.

A study of the lowest five per cent. of college students as determined by the army alpha examination: Helen Marshall.

A study of the highest five per cent. of college students as determined by the army alpha examinations: Earl R. Gabler.

Experimentation in the psychology of music: Esther L. Gatewood.

Mental and educational tests of the deaf: Jeannette Reamer.

Syphilis and delinquency: Florence Mateer.

DEMONSTRATIONS

Black tumor of the catfish: R. C. Osburn.

Some interesting tropical Hemiptera: Herbert Osborn.

Caddis cases covered with sponges: F. H. Krecker.

Wax models of 8 mm. and 12 mm. chondrocrania of *Syngnathus:* J. E. Kindred.

Models of pre-somite (Mateer) human embryo: C. L. Turner.

Specimens from the Valley of Ten Thousand Smokes: Robert F. Griggs.

Wireless telephone: R. A. Brown.

Edward L. Rice,
Secretary

Delaware, Ohio

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.
NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, AUGUST 13, 1920

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

AGRICULTURAL GEOLOGY

DURING reconstruction, as the present period is frequently termed, many new applications of the principles of pure science to special fields of endeavor are being made. The principles of geology thus applied during recent years have given rise to economic geology, mining geology, engineering geology, oil geology and perhaps to that branch of the subject indicated by the above title for it is not entirely new. The application of the principles of the science to the solution of the geological problems that are met in agricultural enterprises and pursuits, in brief, the relation of geology to rural welfare may appropriately be considered as agricultural geology.

Such a problem is that of securing an abundant supply of pure water. In regions of copious rainfall it is essential, in those of average to minimum rainfall it is absolutely necessary to consider the properties and the structure of the substrata in their relation to water in order to obtain such a supply. Pursuant to the requirement of this necessity, the United States Geological Survey maintains a branch of service whose work is concerned with the water resources of the entire country. The purity of subsurface water depends chiefly on the filtering power of the yielding rocks. One of the best natural filters consists of residual material of considerable depth. Some rocks below this mantle are sufficiently pervious to hold, transmit, filter and consequently to yield pure water. Certain others are impervious. Another condition is found where the rocks contain joints or cracks along which water moves freely without filtration, conveying to wells or springs contamination from distant sources. This condition is a strong possibility in limestone regions. Artesian water which, in some localities, flows from wells may be found where the properties and structure of

the containing rock bears such a relation to a supply of water as will produce it. Under one combination of these conditions, as in areas of jointed igneous or metamorphic rocks in the Piedmont belt, an artesian well may yield a few hundred gallons daily; under another, that of a pervious sedimentary rock overlaid by impervious ones which outcrop in a moist region of higher elevation, as in the Great Plains, the yield may be several hundred gallons per minute.

Among the minerals most useful in agricultural pursuits are coal and other mineral fuels, the mineral oils (kerosene and gasoline), iron, salt, gypsum, lime, the minerals of the soil, and the fertilizer minerals yielding potash, phosphates and nitrates. The nature, quality, distribution and availability of most of these substances bear direct relations to their respective geological occurrences. In order that careful discriminations may be made in their purchase and use, those who have need for them should be familiar with their distinguishing properties and with their relative values.

In numerous localities natural gas is obtained from considerable depth. Gas provides fuel and light for use in buildings and power for machinery. Examples of such uses are common in agricultural districts in the gas-producing regions from Pennsylvania and West Virginia via Illinois southwestward to Texas and in other places, where many farmers depend almost wholly on the gas wells for these services. Gasoline for the auto and the tractor is now being extensively made from natural gas. At Anaconda, Montana, the tallest smokestack in the world, 585 feet, was erected to protect vegetation from destruction by smelter gases and soil from ruin by erosion due to this loss of its vegetative cover. Ducktown, Tennessee, and other mining districts afford additional illustrations of these principles. The gases and dust from the smelters, from the blast furnaces of the steel industry and from the flues of the cement mills, through skillfully devised systems of careful collection and concentration, are soon to yield a large proportion of the potash used as fertilizer.

In road building the adaptation of various materials even when only sand and clay are needed is determined by the properties of the minerals and rocks considered for this purpose and by the nature of the base on which the road is to be constructed. In locating a road along or near a slope or in any topographic position where strata outcrop, the drainage and therefore the safety and permanence of the road, or its failure, depend on the kinds of rock involved and on their structural relation. The rapidly growing use of motor vehicles emphasizes the importance of details in regard to road materials and road locations.

From the rocks at the surface or below it, suitable material is obtained for buildings and other structures necessary in agricultural enterprises. Such materials are used in making brick, cement and concrete, in building roads, bridges, dams and retaining walls and in the erection of dwellings and other buildings. A knowledge of the properties and adaptations of structural materials is essential to the intelligent selection of them and to their efficient use. It is also necessary in many localities to understand thoroughly the relations of the substrata to the surface in order to choose safe locations for permanent structures.

The way in which undrained areas were formed has much to do with the solution of the problems that arise when drainage is undertaken and with the kinds of soil reclaimed when the project is completed. Whether an area must be drained by means of surface ditches or whether an exit may be found through a pervious layer of rock below depends wholly on the elevation and on the nature and structure of the substrata. In arid and semi-arid regions the possibility of irrigation as well as the permanence of the aqueduct is dependent also on geologic and topographic factors. Of the sewage disposal plants which are needed on all farms most types can be located with safety in regard to water supply only by considering fully the conditions of geologic structure and materials in the vicinity.

The losses of soil by erosion due to the

action of wind or of water and in some localities due to the additional influence of improper tillage and pasturage bear definite relations to the topography of the area affected. Unfortunately the rich, black humas of the top soil, which is the best part of it, is the first to be removed—a fact that makes early prevention imperative. If the losses are permitted to continue a great succession of gullies and barren ravines soon develops and a worthless area is formed where valuable land could have been retained. The water table is perceptibly lowered over large areas by increased depth of drainage channels or removal of protective cover and this is another serious loss. On the other hand proper drainage may change an alkali soil to a fertile one. The chief processes that cause these losses involve the principle that the transporting power of water various as the sixth power of its velocity. This means that a current whose velocity is three miles per hour can carry more than eleven times as much sediment as one whose velocity is two miles per hour and that a current of three miles per hour loaded to its capacity will, on being reduced to two miles per hour or less, deposit more than 90 per cent. of its load. When a flood current subsides or is checked, an area of rich soil may be covered to a depth of several feet with sand or other worthless material. Prevention and partial restoration of losses may be accomplished as follows: Meandering channels may be replaced by large drainage ditches and with the aid of catchment basins in regions having high rate of rainfall, prevent flooding and erosion of river bottom land. Other losses may be wholly or partly prevented by constructing retaining walls, by the use of tiling or of lined open drains, by contour tillage, by limited pasturage, or by planting trees, shrubs or grasses. Restoration may be partially made by constructing dams or by other means of ponding to check the current and arrest the moving sediment thereby changing the area from one of erosion to one of deposition.

Soil origin finds its explanation chiefly in the field of geology; soil distribution, largely in that of physiography. Different kinds of soils are produced from different kinds of rock or from the same kind of rock when subjected to different processes during the course of origin. For example, soils originating from a given kind of rock in a warm, wet climate will be very unlike those derived from the same kind of rock in a cool, arid region. A third kind of soil will result if the materials from the same kind of rock are transported and sorted by water before forming the final soil; a fourth kind, if transported by glaciation; and a fifth, if deposited by the wind. The various kinds of soil may differ from each other in number of mineral constituents or in the different proportions of each. The development of hills and valleys and other topographic forms by erosion gives rise to a different kind of soil in each topographic location. Kinds of soil arise also in numerous other ways each of which is a response either directly or indirectly to geologic or physiographic processes and conditions.

Classification of soils that they may be subjected to treatment conducive to the greatest production depends chiefly on the accurate use of the principles of soil origin and distribution. The changes recently made by the United States Bureau of Soils in the revision of classification units that were used in mapping a number of years ago afford excellent illustrations of this fact and of its recognition by the Soil Survey. The new divisions formed are based almost wholly on genetic and topographic relations—the principles of geology and physiography being applied to a much greater extent and in greater detail than in the earlier work.

The distribution of vegetation in so far as it is controlled by topography, kind of rock and geologic structure constitutes an important phase of agricultural geology. The distribution of soils, of rainfall, of temperature and of plant and animal life, the location of water courses, of valleys and uplands, of railways, highways and of markets as well as the adaptability of various areas to their respective agricultural uses are, to a remarkable extent, arranged in accordance with the topog-

raphy and with the kinds and relations of the underlying rocks.

The principles of improvement in domestic plants and animals are found in a diligent study of the geological history of their respective races and are fully illustrated in the development of the present forms of life from the ancient ones. These great changes in form, stature and intelligence make some of the useful stories in the earth's history as they are revealed by the record that is written in the rocks. By the study of this history man is encouraged in self improvement and in the realization of his responsibility to the world about him; he is inspired to higher ideals in his relations with his fellow man and in the field of intellectual achievement; he is stimulated to a more intelligent understanding of the powerful forces in nature and of their influence on the origin and on the destination of the human family.

In view of the present awakening to the needs of people in agricultural vocations and of the many relations of this science to rural welfare, it seems reasonable to expect that the study of agricultural geology in colleges and elsewhere will be extended until it is shared by all who are preparing to do work in rural improvement and that each will continue this study long enough to be able to apply the subject with intelligence.

John E. Smith

Department of Geology,
Iowa State College,
Ames, Iowa

THE NOMENCLATURE OF FAMILIES AND SUBFAMILIES IN ZOOLOGY

Recent years have seen gratifying progress in the establishment of permanent rules of zoological nomenclature. Through the Stricklandian Code, the American Ornithologists' Union Code (commonly known as the A. O. U. Code), and, most recently, the International Code, greater uniformity of usage has been achieved than was ever before thought possible.

Family names, however, are still in very much the same state of nomenclatural chaos as were generic and specific names before the adoption of the Stricklandian Code in 1842. Zoological family and subfamily names have come and continued in use by a sort of *auctorum plurimorum* principle; and though current usage is more or less satisfactory so long as every one is agreed, any serious difference immediately causes trouble. Rules by which workers will agree to be bound, therefore, become necessary; and this, it were trite to say, is the reason for any code of nomenclature. Certain authors, however, have recently begun, for reasons other than zoological, to change many family names long in use, and it is, therefore, pertinent now to inquire into the desirability of such changes, and of the formulation of some principles for guidance. Since family and subfamily designations must depend on generic names, they are more in need of definite rules than are the names of still higher groups.

Latreille, in his "Précis des Caractères Générique des Insectes," published in 1796, was the real originator of the family concept in zoology, but he first designated these groups by number, though in a later work adopted plural Latin names with differing terminations. William Kirby, an English naturalist, in a paper on a new order of insects,[1] was the first to advocate the adoption of uniform patronymic endings in "*idæ*." The idea was soon afterwards adopted and elaborated by W. E. Leach, and subsequently by other authors, so that it was brought into general use during the succeeding decade. In 1825, N. E. Vigors, in a paper on the classification of birds, provided an entire set of family names with the ending *idæ*. It is of interest to note, in this connection, that German authors were far behind the English in adopting this improvement in terminology. Subfamily names in "*inæ*" did not come into general use until about the year 1830.

The first definite formulation of the principle of patronymic endings for family and subfamily names was in the Stricklandian

[1] *Trans. Linn. Soc. London*, XI., 1813, p. 88, footnote.

Code,[2] and is introduced in the following language:

B. It is recommended that the assemblages of genera termed *families* should be uniformly named by adding the termination *idæ* to the name of the earliest known, or most typically characterized genus in them; and that their subdivisions, termed *subfamilies*, should be similarly constructed, with the termination *inæ*.

The next epoch-making code of nomenclature, the A. O. U. Code of 1886, Canon V., adds to this only the proviso:

When a generic name becomes a synonym, a current family or subfamily name based on such generic name becomes untenable.

The revised A. O. U. Code of 1908 made no change in this.

The International Code of 1913 has only the following provisions regarding family and subfamily names:

Article 4. The name of a family is formed by adding the ending *idæ*, the name of a subfamily by adding *inæ*, to the root of the name of its type genus.

Article 5. The name of a family or subfamily is to be changed when the name of its type genus is changed.

The Entomological Code,[3] prepared chiefly by Messrs. Nathan Banks and A. N. Caudell, contains so many additional provisions regarding family and subfamily names that it seems worth while to quote entire the portions pertinent to the present discussion:

108. The name of a family shall be formed by changing the last syllable of the genitive case of an included generic name (preferably the oldest) into *idæ*.

109. The name of a subfamily shall be formed by using "*inæ*" in place of the *idæ*. One of the subfamily names shall be based on the same generic onym, or is removed from the family or subfamily, is a part.

113. The name of a family or subfamily is to be changed when the basic generic name is a homonym, or is removed from the family or subfamily, or becomes a synonym.

114. If there are two or more names proposed for the same family or subfamily ending in *idæ* or *inæ*, the earlier name shall be adopted.

15. If there are two family or subfamily names of the same spelling, the more recent shall be replaced, or so modified as not to conflict.

Recent multiplication of family and subfamily names in zoology and their dependence on generic designations make very desirable, in fact, almost necessary, definite rules for their selection and use. In any such rules, families and subfamilies should be treated alike (except, of course, for their difference in termination) just as are genera and subgenera.

The above-quoted codes of nomenclature fail to provide a perfectly satisfactory rule for the stabilization of family and subfamily names, as is fully realized by those who have had to deal with such designations. This is principally because these codes neglect particularly to define the term "type genus," *i. e.*, the genus on which the family name is based, and to specify the method of its selection. There are three methods that have heretofore been depended on for the determination of type genera and the consquent formation of family names; use of (1) the most characteristic genus; (2) the genus whose name is the oldest in the group; and (3) the genus which first formed the basis of a family name.

The first of these methods apparently was the consideration influencing most of the early writers, though there are indications that in many cases the genus for the family name was chosen at random. The objections to this first method are that it is not definite enough; that it depends on too many zoological conditions; and that it is open to continual alteration as the limits of the group change by the admission of other genera which might by some authors be considered more differentiated. In other words, this method of selecting the type genus is too much a matter of personal opinion in its zoological aspect to be of value as a nomenclatural rule.

[2] Report Brit. Association Adv. Sci. for 1842 (1843), pp. 105–121.

[3] "The Entomological Code, a Code of Nomenclature for use in Entomology," May, 1912.

The second method above mentioned, the use of the oldest name within any circumscribed family or subfamily group, is one that a number of modern zoologists use, although almost never with entire consistency, and it needs more careful consideration than the first. It possesses, it must be admitted, the advantage of definiteness and of easy application, but it likewise has several disadvantages which at once become evident when we attempt to apply it to all existing families alike, as we must do in pursuance of the main object of a nomenclatural rule. The most serious of these objections are as follows:

1. A family name would be changed when any genus with an older name than any of its original components is added to the group.

2. Any transference of a generic name to a genus of another family in which such generic name would be older than any already in that family would cause confusion in the transfer of the family name, a result that is always very undesirable.

3. The universal application of this rule would make wholesale changes in familiar family names in almost all branches of zoology, since until recently the use of the oldest genus was apparently only accidental, or because it happened to be the most prominent or characteristic group in the family. This is especially the case with the older authors; and the use of the oldest generic name is not by any means current practise among modern writers, even entomologists, since examination of Dr. Dalla Torre's "Catalogus Hymenoptorum" shows at once that a number of the subfamily and family names that he uses are evidently chosen by another method, for they are not based on the oldest genus included by him in their respective family or subfamily groups. Merely a *few* of the names that would have to be changed were this rule of the oldest generic name enforced are, in Hymenoptera: Ctenopelmatinæ, Dacnusinæ, Euphorinæ, Tetrastichinæ, Tetracampinæ, Tridyminæ; in mammalogy, Desmodontidæ, Oxyænidæ, Oxyclænidæ, Chinchillidæ, Dasyproctidæ, Erethizontidæ, Microtinæ; in ornithology, Ichthyornithidæ, Rallidæ, Gruidæ, Ciconiidæ, Œdicnemidæ, Cathartidæ, Phasianidæ, Picidæ, Capitonidæ, Pycnonotidæ, Ploceidæ and Frigillidæ.

4. Most important of all, it would prevent a definite and permanent concept of the type genus, since this would be constantly shifting by reason of the addition, subtraction, and changes of names.

The third method for the determination of the type genus is the use of the genus from the name of which a family designation was first formed, and the retention of this genus as the family type, whatever its name becomes. The chief objection to this is that it involves search through the literature for the earliest dates of family names, similar to that already made for generic terms. This, however, is not such a great task as might at first appear. In fact, Agassiz, in his "Nomenclator Zoologicus," has made a substantial beginning in this direction for all groups of zoology; while Dalla Torre has performed this service for Hymenoptera; Dr. T. S. Palmer, in his "Index Generum Mammalium," for mammals; and Mr. Robert Ridgway, in his "Birds of North and Middle America," for a part of the birds.

Its advantages do away with the chief drawbacks of the "oldest genus" rule. Most important, it provides a definite and permanent family concept in some generic group. Furthermore, it will prevent all changes in family names from the addition of genera or from alterations of generic names (other than of the type genus) within the family; it will obviate nearly all the transference of family names to unfamiliar associations, with the consequent confusion; and will cause comparatively few changes in the current designations of families.

To adopt any rule will necessarily involve some alterations in current family and subfamily names, but apparently far fewer changes result from what might be termed the "permanent type genus" rule than from that which selects the oldest generic name. The latter has the advantage of easier application and involves less research, but is not nearly so logical nor so scientific as the rule

which provides for a permanent type genus, since this rule corresponds almost exactly to the method of determining the type species of a genus.

A demonstration of the advantage of the "permanent type genus" rule is to be found in the case of the family Bubonidæ, to which the writer has elsewhere already called attention.[4] The generic name *Strix* Linnæus has been, by the mutations of nomenclature, transferred from the barn owls, family Strigidæ, to the horned owls, family Bubonida, and instated there as the proper name for the genus formerly known as *Syrnium*. It thus becomes the oldest generic name in the family Bubonidæ, and by the "oldest genus" rule would require the change of the name Bubonidæ to Strigidæ. By the third method above discussed, the genus *Bubo*, from which the family name Bubonidæ is formed, continues as the type genus, and no change in the name of the family Bubonidæ, into which the generic name *Strix* is introduced, is necessary. The family name Strigidæ would, in this case, disappear entirely, for the generic term *Strix*, removed from the former family Strigidæ, necessitates a change in this name Strigidæ to Tytonidæ, based on *Tyto*, the new name of its type genus formerly known as *Strix*. Thus, *the same generic group in each of these families would continue to remain the type genus, just as a species, whatever its name becomes, remains the type of a genus*. This method of a permanent type genus has been recently endorsed in print, at least inferentially, in the Entomological Code;[5] by Dalla Torre, as an examination of his "Catalogus Hymenoptorum" clearly shows; by Dr. C. W. Richmond in the case of the family Threskiornithidæ;[6] and definitely by Mr. E. P. Van Duzee[7] and Dr. Witmer Stone.[8] Furthermore, the following specialists in various groups, many of whom have personally furnished valuable suggestions, have given their approval to the principles and rules here presented:

Dr. T. S. Palmer; Dr. Witmer Stone; Mr. J. A. G. Rehn; Dr. C. W. Richmond; Dr. W. H. Dall; Dr. P. Bartsch; Dr. O. P. Hay; Mr. G. S. Miller; Mr. N. Hollister; Mr. J. W. Gidley; Mr. A. N. Caudell; Major E. A. Goldman; and Dr. W. H. Osgood.

Since some rule for the determination of the type genus is evidently necessary in order to stabilize family and subfamily names in zoology, the adoption of the third and last method above discussed, *i. e.*, that providing for a permanent concept of the type genus, is now advocated.

For the sake of completeness it seems worth while to formulate the following tentative nomenclatural rules for the determination and treatment of family and subfamily names. These embody all the above provisions in modern codes, with some additions, including that for the type genus just mentioned, and provide for the most important contingencies that may arise.

RULES FOR FAMILY AND SUBFAMILY NAMES

1. The name of a family is to be formed by adding the ending *idæ* to the stem of the tenable name of its type genus.

2. The name of a subfamily is to be formed by adding the ending *inæ* to the stem of the tenable name of its type genus.

3. Subfamily names shall for purposes of nomenclature be accorded the same treatment as family names.

4. The type genus of a family or subfamily must be one of its included genera.

5. The type genus of a family or subfamily is the included generic group from the name of which the family or subfamily name was originally formed, and is to remain the type genus irrespective of changes in its name.

6. A family or subfamily name formed from the name of an included genus is valid whether or not originally accompanied by a diagnosis, or by specific mention of the type genus.

[4] *Proc. U. S. Nat. Mus.*, LII., February 8, 1917, p. 190.

[5] Entomological Code, May, 1912, Rule 114, p. 22.

[6] *Proc. U. S. Nat. Mus.*, LIII., August 16, 1917, p. 636.

[7] *Ann. Entom. Soc. Amer.*, IX., 1916, pp. 89–91.

[8] *Auk*, XXXIV., No. 2, April, 1917, p. 228.

7. The law of priority, subject to that of generic names, shall be fully operative in relation to family and subfamily names.

Remarks.—This, of course, in cases where changes in family names become necessary, should not be held to apply to the use of any names that are not based on the type genus. (See remarks under Rule 12.)

8. In the application of the law of priority, consideration is to be given to all names employed respectively in a family or subfamily sense; and to all supergeneric group names not higher than the grade of family, if based on an included genus; but any such names when brought into use must have their endings changed to *idæ* or *inæ* if they were originally proposed with other terminations.

Remarks.—The necessity for some such rule is obvious, since many early authors, like Swainson, Vigors, and Bonaparte, used plural names with other terminations, such as *ina* and *ini*, which, of course, deserve consideration in determining the priority of family or subfamily names. Some authors, moreover, who extensively employed the terminations *idæ* and *inæ*, changed the penultimate syllable in the family name to "a" whenever necessary to conform to classical usage (*e. g.*, Sylviadæ, Laniadæ); and it is, of course, desirable to retain such names, but with the regular ending. Furthermore, this rule involves the treatment of all supergeneric group terms not higher than the grade of family as potential family or subfamily names.

9. When a family or subfamily is divided, its name is to be retained in both family and subfamily sense for that part containing the type genus of the original group. The remaining portion should take as its family or subfamily designation the earliest name based on any of its included genera. If there is no such name, the family or subfamily may take for its type genus any included genus, preferably the most characteristic or best known.

10. When a subfamily is raised to family rank, its type genus is to be retained as the type genus of such family group.

11. The family or subfamily formed by the combination of two or more families or subfamilies takes for its type genus the generic group in any of its components that was first made the basis of a family or subfamily name.

12. When for any reason the name of the type genus of a family is changed, the dependent family name must be changed to correspond to the new designation of the type genus.

Remarks.—Such change in the name of a type genus occurs whenever the generic term is found to be a homonym or synonym or is transferred to another family group. Since, of course, a family or subfamily designation must be based on the *tenable* name of its type genus, there is obvious necessity for a corresponding change of the family or subfamily name whenever any alteration takes place in the name of the type genus. In such case, to use a family name already proposed but based on another genus would thereby change the type genus of the family and violate Rule 5.

13. Of two family or subfamily names in zoology having exactly the same spelling, the later is to be distinguished from the earlier by the prefix "*Pro*": hypothetical example, Propicidæ.

Remarks.—Such preoccupation occurs when generic terms having the same word-stem are the bases of two or more family names; and to obviate the use of family names identical in spelling necessitates the selection of another designation in place of the family name invalidated. To replace the later name by one based on a newly selected type genus would be the logical method, were it not impossible in the case of monotypic family groups. Similarly, the use of a new family name formed by the addition of *idæ* to the nominative case instead of to the stem of the name of the type genus, would not avail should the nominative case happen to be the same as the stem.

The use of the prefix "*Pro*," which we have selected on account of its meaning and its brevity, seems to be the most satisfactory rule that can be devised for such cases. For

segregate *Pica* Brisson, as the type and only genus of a separate family, the name of such family could not well be Picidæ, since this is already in use for another group, with *Picus* Linnæus as basis. Consequently the name of the family containing *Pica* would become *Propicidæ*.

HARRY C. OBERHOLSER
U. S. BIOLOGICAL SURVEY

FURTHER RESULTS OF ANALYSIS OF LIGHT DEFLECTIONS OBSERVED DURING SOLAR ECLIPSE OF MAY 29, 1919

1. SINCE the article in SCIENCE of June 11, 1919 (pages 581–585) was written, we have received through the kindness of the Astronomer Royal the printed "Report"[1] giving in detail the reductions and results of the light deflections observed by the two British expeditions during the solar eclipse of May 29, 1919. On the basis of the information in the "Report" we have made an independent reduction of the photographic measures resulting from Crommelin's plates.

The non-radial effects, as resulting from our calculations, are found to be on the average about one third of those derived from the British printed results and as given in the seventh column of Table II. of the previous article in SCIENCE (see page 583); in brief, *our non-radial effects are on the order of the error of observation, so that they may be regarded as non-existent until other observational evidence is obtained.*

2. Table I. contains the revised radial light deflections resulting from all reductions; they are subject to some slight changes when some required additional information has been received. Comparing the observed deflections with those computed on the basis of the Einstein theory of gravitation, it will be seen that generally the observed deflection is greater than the theoretical value.

TABLE I

Radial Light Deflections, May 29, 1919, at Sobral

No.	Star	Dist.[2]	Deflection Obs'd.	Deflection Einstein	O–E
3	κ_2 Tauri	1.99	1".00	0".88	+0".12
2	Pi. IV. 82	2.04	1.00	0.85	+0.15
4	κ_1 Tauri	2.35	0.83	0.74	+0.09
5	Pi. IV. 61	3.27	0.57	0.53	+0.04
6	υ Tauri	4.34	0.55	0.40	+0.15
10	72 Tauri	5.19	0.35	0.34	+0.01
11	56 Tauri	5.38	0.31	0.32	−0.01

Star 11, the most distant star, according to the British reductions showed a deflection agreeing better with the value calculated on the basis of the Newtonian Mechanics, but it now shows a deflection agreeing better with the Einstein value. In brief, the results of all reductions would lend additional support to the conclusion reached by the British astronomers, namely, that, as judged by their best photographic plates, the light deflections observed during the solar eclipse of May 29, 1919, accorded better with the calculated values on the basis of the Einstein theory than on the basis of the Newtonian Mechanics.

3. Comparing the observed deflections with the theoretical ones, as given in Table I., it would seem that the former decrease with distance more rapidly than do the latter. Whether this implies that the observed light deflections were the combined effects of the sun's gravitational action and a solar atmospheric action of some kind can possibly not be settled definitely until further observational evidence has been obtained.[3]

LOUIS A. BAUER
DEPARTMENT OF TERRESTRIAL MAGNETISM,
WASHINGTON, D. C.,
July 17, 1920

[1] "A Determination of the Deflection of Light by the Sun's Gravitational Field from Observations made at the Total Eclipse of May 29, 1919," by Sir F. W. Dyson, F.R.S., astronomer royal; Professor A. S. Eddington, F.R.S., and Mr. C. Davidson, *Phil. Trans. R. S.*, London, Ser. A., Vol. 220, pp. 291–333. [The longitude of Sobral, as given on page 296, should read $2^h\ 41^m\ 25^s$ west, instead of $2^h\ 47^m\ 25^s$.]

[2] Expressed in units of the sun's radius.

[3] It may be suggestive that the light ray from star 2, which according to Table I. differed largely from the Einstein value, passed through the solar atmospheric region directly above the remarkable prominence on the southeast limb of the sun.

SCIENTIFIC EVENTS

CHEMICAL RESEARCH IN FRANCE AND ENGLAND

THE Paris correspondent of the *Journal of Industrial and Engineering Chemistry* writes: "Scientific research is at this moment passing through a serious crisis. It is going to lack personnel. The alarm has been sounded by Professor Daniel Berthelot, the son of Marcellin Berthelot. In a recent speech he called attention to the utilitarian direction of all scientific research, and more especially chemical. We have here in France many schools of chemistry, but they are all schools of industrial chemistry. Almost without exception they are concerned with producing the industrial chemist, and, little by little, we are seeing the laboratories attached to professorships abandoned—laboratories such as that of Fremy at the Museum of Natural History, which have been the nurseries of the research chemists. The necessity which the younger generation feels of earning a living as soon as possible is the cause of this state of affairs. Add to this that most of the laboratories lack funds and can not bear the costs of theoretical research whose economic profit may be far distant. The public authorities, however, seem willing to consider these questions, and to-day, for instance, you may see in the French parliament, a deputy, Mr. Maurice Barres, offer one of the arguments which you Americans have so wisely brought to the solution of the social problem: 'It is useless to quarrel with wealth; it is better to use its activity to create more; and in this creation of wealth we chemists have a large duty to fill.'"

The London correspondent says: "In applied chemistry we are faced in Great Britain with a state of uncertainty and chaos without parallel in the recollection of any of us. No one can form any just estimate of the future supply or price of coal or other fuels; no one has any sure data upon which to base an opinion as to the future of the principal metals and other raw materials. Accounts from Germany and Austria are singularly conflicting and it is not easy for us to know whether in chemical industry we are to export to those countries at a reasonable profit or whether we shall suffer from acute competition from those countries. And in our own financial state nothing seems certain beyond the fact that grievous and necessary taxation will continue for a long period and will hamper the development of business and the starting of new enterprises. We have recently lived through times infinitely more anxious, and our neighbors in France and Italy have far more difficult problems to solve than we have. Our anxieties are as nothing to theirs and the state of political industrial and financial chaos in Germany, Austria and Russia is such as to be beyond conception. We are not merely perplexed by this; the aspect continually changes and it is hopeless for us to try and imagine what will happen in the east of Europe. In time some sort of settlement or stability will be achieved, but the details of the process are beyond the wit of man to imagine."

MEDICAL EDUCATION IN THE UNITED STATES

FOR the twentieth consecutive year the *Journal* of the American Medical Association publishes this week statistics dealing with medical education in the United States. In all medical schools during the last session there were 14,088 students, or 1,036 more than during the previous session. These increases are in the first, third and fourth year classes, smaller second year classes following the small freshman enrolment in the fall of 1918 caused by war conditions. The increased enrolments have been most marked in Class A medical schools, the number enrolled this year having increased from 87.9 to 89.6 per cent. of all students. The percentage in Class B schools decreased from 8.3 to 4.8, and in Class C schools it increased from 3.8 to 5.6.

The number of graduates this year was 3,047, or 391 more than in 1919. The number of graduates of Class A colleges was increased by 470, while the numbers graduating from Class B schools decreased by 116. Of the Class C colleges, there were 37 more graduates than in the previous year. The number of graduates holding degrees from colleges of

arts and sciences increased from 1,180 to 1,321, which is 43.5 per cent. of all graduates.

The number of medical colleges is eighty-five, the same number as last year. In 1904, when the Council on Medical Education was created, the United States had more medical schools than all other countries of the world combined. While the number of colleges has been reduced from 162 to 85 during the sixteen years, the number enforcing an entrance requirement of two years or more of collegiate work increased from four (2.5 per cent. of all colleges) in 1904, to seventy-eight (92.9 per cent.) in 1920. The number of medical students was decreased from 28,142 to 13,052—the lowest number—in 1919; but during the same period, the number who had higher preliminary qualifications was increased from 1,761 (6.2 per cent. of all students) in 1904, to 13,408 (95.2 per cent.) in 1920. The number of graduates was reduced from 5,747 to 2,656—the lowest number—in 1919; but the number having higher preliminary qualifications was increased from 369 (6.4 per cent. of all graduates) in 1904, to 2,842 (93.3 per cent.) in 1920.

WORK OF THE BUREAU OF MINES

Dr. F. G. Cottrell, director of the Bureau of Mines, announces the appointment by Acting Secretary of the Interior Hopkins, of F. B. Tough as supervisor, and R. E. Collom and H. W. Bell as deputy supervisors, to administer the operating regulations on oil and gas leases under the Department of the Interior. Mr. Tough will be stationed at Denver, Colorado, and will have personal charge of operations in the Rocky Mountain fields, as well as supervisory charge of operations on government lands in all fields. Mr. Collom will be stationed at San Francisco, California, and will have charge of operations in the California oil fields. Mr. Bell will be stationed at Dallas, Texas, and will supervise operations in the Louisana fields.

Mr. Tough is a graduate mining engineer. He has had seven years' experience in actual engineering and practical work for the Southern Pacific Company in the California oil fields and as petroleum technologist with the Bureau of Mines for four years. While with the Bureau of Mines, he covered practically all the oil fields in the United States, and has done much work in correcting water problems in Illinois, Colorado, Wyoming and California. He is the author of Bulletin 163, "Methods of Shutting off Water in Oil and Gas Wells." For the past year and a half he has been in charge of the conservation work in the Wyoming fields, under the cooperative agreement with the Rocky Mountain Petroleum Association, which has contributed $30,000 a year for the Bureau of Mines to demonstrate methods of drilling and operating wells in order to minimize the waste of oil and gas and damage to oil and gas sands. This work was so satisfactory that the Rocky Mountain Petroleum Association, consistng of the Midwest Refining Company, the Ohio Oil Company, and the Continental Oil Company, voluntarily suggested a renewal of the cooperative agreement for the second year and Mr. Tough will continue to supervise this cooperative work.

Mr. R. E. Collom is also a graduate mining engineer. He has had a number of years' experience in the mining camps, but has spent most of his time in the oil fields of California. He was deputy supervisor for the California State Mining Bureau, where he worked principally in the Santa Maria oil field, from which position he was transferred to San Francisco as assistant chief supervisor. Mr. Collom has been with the Bureau of Mines for one year, during which time he has been in many fields in the United States, and was in charge of the Dallas office of the Bureau of Mines for several months. He worked in the Texas and Louisiana oil fields, particularly in the Wichita Falls and Ranger Districts, where, with the assistance of W. A. Snyder and J. B. Kerr, a number of operating problems were solved and valuable recommendations made to the oil companies. Mr. Collem is the author of a manuscript to be published by the Bureau of Mines relating to development problems in the oil fields.

Mr. Bell is a graduate mining engineer

who spent a number of years in the mining camps, and then became interested in the oil business in Coalinga field, California, where he had much practical experience. For the past several years he has been with the California State Mining Bureau as deputy supervisor. He has recently been appointed as petroleum engineer with the Bureau of Mines, to take charge of the Dallas office, Texas. Government leases in Louisiana will be taken care of in conjunction with the demonstration work in Louisiana and Texas.

The supervisory work under Mr. F. B. Tough will cover the operating regulations to govern the production of oil and gas under the Act of February 25, 1920. These regulations cover only the active drilling, production, and gaging of oil and gas, the supervision of which has been assigned to the Bureau of Mines by the Honorable John Barton Payne, secretary of the interior. Other regulations relating to the giving of leases and permits, collection of royalty moneys, etc., are under the supervision of the General Land Office.

The operating regulations, before being submitted to the secretary of the interior, were submitted to representatives of the oil industry in the states concerned at a conference held in Washington under Assistant Secretary of the Interior Vogelsang, on April 1 and 2. These regulations, therefore, have the approval of representatives of the industry with practical field and business experience in oil and gas. The administration of the regulations will be undertaken by experienced engineers.

THE REORGANIZATION OF THE NELA RESEARCH LABORATORIES

THE Nela Research Laboratory was organized in 1908 under the directorship of Dr. Edward P. Hyde as the physical laboratory of the National Electric Lamp Association. The name was changed to Nela Research Laboratory in 1913, when the National Electric Lamp Association became the National Lamp Works of General Electric Company. For some years the laboratory was devoted exclusively to the development of those sciences on which the art of lighting has its foundation, but in 1914 the functions of the laboratory were extended by the addition of a small section of applied science, which had an immediate practical objective.

The section of applied science is now being largely extended as a separate laboratory of applied science under the immediate direction of Mr. M. Luckiesh, who becomes director of applied science, and a new building is being constructed to house this branch of the work, which will be carried forward with a staff of several physicists, an engineer, an architect and a designer, together with the necessary technical and clerical assistants.

As has already been noted in SCIENCE, Dr. Ernest Fox Nichols, formerly president of Dartmouth College, and more recently professor of physics at Yale University, has accepted an invitation to assume the immediate direction of the laboratory of pure science, under the title of director of pure science. The work of this laboratory, which will be continued in the present building, will be somewhat further extended under the new organization.

The Laboratory of Pure Science and the Laboratory of Applied Science will together constitute the Nela Research Laboratories, and will be coordinated under the general direction of Dr. Hyde, who becomes director of research.

THE LISTER MEMORIAL

AT a public meeting held at the Mansion House, London, in October, 1912, the following proposals for commemorating the work of Lord Lister were adopted: "The placing of a memorial in Washington Abbey, to take the form of a tablet with medallion and inscription; the erection of a monument in a public place in London; and the establishment of an International Lister Memorial Fund for the achievement of surgery, from which either grants in aid of researches bearing on surgery or awards in recognition of distinguished contributions to surgical science should be made, irrespective of nationality." *Nature* reports that a meeting of the general committee was held in the rooms of the Royal Society on

Monday, July 19, to receive and adopt the report of the executive committee appointed in 1912. The chairman, Sir Archibald Geikie, stated that the sums received in respect of subscriptions from the British Empire and foreign countries amounted to £11,846 5s. 10d. A memorial tablet, executed by Sir Thomas Brock, was unveiled in Westminster Abbey on November 1, 1915, and steps are being taken for the erection of a monument in a public place in London. In order to carry out the scheme for the establishment of the International Lister Memorial Fund for the Advancement of Surgery, it was resolved that: (*a*) Out of the general fund a sum of £500, together with a bronze medal, be awarded every three years, irrespective of nationality, in recognition of distinguished contributions to surgical science, the recipient being required to give an address in London under the auspices of the Royal College of Surgeons of England. (*b*) The award be made by a committee constituted of members nominated by the Royal Society, Royal College of Surgeons of England, Royal College of Surgeons in Ireland, University of Edinburgh, and University of Glasgow. (*c*) Any surplus income of the general fund, after providing for the erection of a monument and defraying administrative expenses, be either devoted to the furtherance of surgical science by means of grants or invested to increase the capital of the fund. The Royal College of Surgeons of England has consented to become the trustees and administrators of the Lister Fund and to carry out its objects, subject to the above provisions of the scheme. The subscription list is still open, and the honorable treasurer of the fund is Sir Watson Cheyne, Bart., to whom donations may be addressed at the Royal Society, Burlington House, London, W. 1.

SCIENTIFIC NOTES AND NEWS

CAMBRIDGE UNIVERSITY has conferred the degree of doctor of laws on Dr. John J. Abel, professor of pharmacology at the Johns Hopkins Medical School, and on Dr. Harvey Cushing, professor of surgery in Harvard University.

DR. WILLIAM W. KEEN, professor emeritus of surgery at the Jefferson Medical College, president of the International Surgical Society, recently in conference at Paris, presided at the opening sessions.

PROFESSOR M. T. BOGERT, of Columbia University, recently nominated a tariff commissioner by President Wilson, has declined the appointment.

DR. JOHN G. ADAMI, vice-chancellor of the University of Liverpool, formerly professor of pathology and bacteriology in McGill University, has been elected to an honorary fellowship in Christ's College, Cambridge.

THE *Journal* of the American Medical Association reports that having reached the age limit, Dr. Amalio Gimeno y Cabañas, professor of pathology at the University of Madrid, senator and at one time minister in the cabinet, was given an ovation in the university amphitheater at a special gathering for the purpose. He was presented with a medallion and a banquet followed.

PROFESSOR ALBERT S. FLINT, of the department of astronomy of the University of Wisconsin, retires from active work this month after thirty-one years of service on the university faculty. He will continue his association with the department as emeritus professor of astronomy.

DR. MARCUS BENJAMIN, editor of the publications of the United States National Museum in Washington, has received from the French minister of public education the award of the Palms, with the rank of "Officier de l'instruction publique."

THE Canadian Council of Scientific and Industrial Research has awarded $5,000 to Professor J. C. McLennan, of the University of Toronto, for his research into the properties of helium.

THE Prussian Academy of Science has granted Dr. Agnes Bluhm 1,000 Marks to continue her experimental work on problems of heredity.

DR. SAMUEL W. HAMILTON, of the Utica State Hospital, has been appointed chief medical di-

rector of the Hospital for Mental Diseases, Philadelphia.

Charles S. Howard, formerly an instructor in the department of electrical engineering and physics at the U. S. Naval Academy, has accepted a position as junior chemist in the Quality of Water Division of the Water Resources Branch of the U. S. Geological Survey, Washington, D. C.

Mr. W. D. Collins has left the Bureau of Chemistry of the Department of Agriculture to take charge of work on quality of water for the U. S. Geological Survey.

Dr. Charles L. Parsons, secretary of the American Chemical Society, has returned to Washington following the adjournment of the International Union of Pure and Applied Chemistry at Rome, where he acted as the American representative.

W. S. W. Kew, of the U. S. Geological Survey, is studying the oil conditions of northwestern Mexico for private parties while on furlough from the government service.

R. B. Moore, chief chemist of the Bureau of Mines, and Dorsey Lyon, supervisor of mining experiment stations, are going south to inspect sites suggested for a mining experiment station to deal with problems of non-metallic mining, as provided for at the last session of Congress.

The *Journal of Industrial and Engineering Chemistry* records changes in positions as follows: A. J. Lewis has resigned from the Bureau of Standards, where he was engaged in paint and varnish analysis as assistant chemist, and is at present with the H. H. Franklin Manufacturing Co., Syracuse, N. Y., as research chemist in paints, varnishes and enamels. Dr. Fred C. Blanck has resigned as food and drug commissioner of Maryland and associate in chemistry in the Johns Hopkins University to accept a position as director of inspection in the Del-Mar-Via Inspection District of the National Canners Association, with headquarters at Easton, Md. Dr. R. L. Sebastian, formerly engaged in magnesite investigation with the U. S. Bureau of Mines, Berkeley Station, Calif., has accepted a position as research chemist with the Barrett Co., Frankford, Pa. Mr. Arthur C. Metcalf has resigned as junior chemist, Bureau of Chemistry, U. S. Department of Agriculture, to become chemist for the Republic Packing Corp., Lockport, N. Y. Mr. Ferdinand A. Collatz has resigned his assistantship in the department of biochemistry, University of Minnesota, to accept a research fellowship with the American Institute of Baking, Minneapolis, Minn.

We learn from *Nature* that the civil list pensions granted during the year ended March 31 include: Mrs. Howell, in recognition of her late husband's eminent public service in the Geological Survey of Great Britain, £50; Miss Juliet Hepworth, in recognition of her late brother's services to meteorology and oceanography, £50, and Mrs. K. Macdonald Goring, in recognition of her husband's services to biometrical science, £85.

"Trends in Psychology" was the subject of an address delivered on July 22 at Stanford University by Professor W. V. Bingham, of the Carnegie Institute of Technology.

At the request of the Röntgen Society, Dr. W. D. Coolidge, of the research laboratories of the General Electric Company, gave an address on July 15 at University College, London.

Dr. Richard A. Berry, professor of anatomy in the University of Melbourne, has been appointed Stewart lecturer for 1921 in that university. Professor Berry has recently, in conjunction with Mr. S. D. Porteus, director of the research laboratory of the training school at Vineland, New Jersey, issued a report describing a practical method for the diagnosis of mental deficiency and other forms of social inefficiency, and will devote his Stewart course to this subject.

Dr. J. Bucquoy, president of the Paris Academy of Medicine, has died at the age of ninety-one years. He had attended the meetings of the academy to the day before his death, which was due to a street accident.

The death is announced of Dr. T. Debaisieux, one of the most eminent surgeons of Belgium, and emeritus professor of sur-

gery at the University of Louvain. Before his death, Dr. Debaisieux had the gratification of seeing his son appointed to the chair which he himself had held for many years.

THE American Public Health Association will meet in San Francisco, September 13-17. The program will include the Relative Functions of Official and Non-Official Health Organizatons; Western Health Problems; Narcotic Control; Food Poisoning; Organization for Child Hygiene; Mental Hygiene; Health Centers. These subjects and others will be distributed among the following ten sectional groups: General Sessions; Public Health Administration; Laboratory; Vital Statistics; Sociological; Sanitary Engineering; Industrial Hygiene; Food and Drugs; Personal Hygiene; Child Hygiene.

THE *Journal* of the American Medical Association states that Dr. F. F. Simpson, of Pittsburgh, recently spent several months in Europe with a view to interesting the medical profession of the world in the project of reorganizing on a uniform basis all international societies related to the various branches of medicine. It is proposed to create a federation of these societies and to establish an international medical press bureau which shall be charged with making known all important discoveries to the medical press of the world, thus assuring rapid diffusion of medical knowledge. A committee of ten, composed of two physicians from each of five countries, Belgium, France, Great Britain, Italy and the United States, has been named and will meet soon in Paris or London to set the new organization on foot.

WE learn from *Nature* that a congress of Philosophy to which members of the Société Française de Philosophie and the American Philosophical Association are sending delegates, is to take place at Oxford on September 24–27. Two of the subjects of discussion are likely to be of especial scientific interest: one a symposium on the principle of relativity, to be opened by Professor Eddington, and the other a discussion to be opened by Dr. Head on disorders of symbolic thinking due to local lesions of the brain. The opening meeting of the congress will be presided over by Professor Bergson. Arrangements are under the direction of Mr. A. H. Smith, New College, Oxford.

UNIVERSITY AND EDUCATIONAL NEWS

GIFTS of $150,000 each to Bowdoin and University of Maine, $70,000 to Coes Northwood Academy at Durham, N. H., and $10,000 to the Eastern Maine General Hospital are included in the will of Dr. Thomas Opham Coe.

SIR JESSE BOOT has given £50,000 to the new Nottingham University scheme—£30,000 for building and £20,000 for a chair of chemistry. A gift of £15,000 has been made to Liverpool University by Alderman Louis Samuel Cohen. A further gift of £6,000 has been received by the University of Cambridge from Mr. and Mrs. P. A. Molteno to meet the increased cost of labor and material in the building of the Molteno Institute of Parasitology.

DR. CHARLES HUBBARD JUDD, head of the department of education of the University of Chicago and director of the school of education, has been made chairman of the department of psychology to succeed Professor James R. Angell, who resigned to accept the presidency of the Carnegie Corporation of New York.

PROFESSOR ARTHUR M. PARDEE has resigned from the chair of chemistry at Washington and Jefferson College, Washington, Pa., to become the head of the department and professor of chemistry at the University of South Dakota, Vermillion, S. D.

AT the University of Arizona, Mr. J. G. Brown has been promoted from an assistant professorship in biology in the college of arts and science to the position of professor of plant pathology in the college of agriculture and plant pathologist of the Agricultural Experiment Station.

DR. DWIGHT E. MINNICH, instructor in physiology and zoology at Syracuse University, has become instructor in animal biology at the University of Minnesota.

The British Medical Journal reports that professors of the Paris Faculty of Medicine have been placed in two classes according to their seniority, those in the first class receiving a salary of 25,000 francs and those in the second class a salary of 23,000 francs. By a recent ministerial decree Professors Richet, Pouchet, Hutinel, De Lapersonne, Gilbert, Roger, Nicolas, Ribemont-Dessaignes, Quénu, Prénant, Widal, Chauffard, and Weiss have been put in the first class, and Professors Delbet, Marfan, Hartmann, Bar, Marie, Broca, Teissier, Desgrès, Lejars Achard, Robin, Legueu, Letulle, Couvelaire, Carnot, Besançon, Vaquez, Dupré and Jeanselme in the second class.

DISCUSSION AND CORRESPONDENCE

TRANSVERSE VIBRATIONS OF RODS

To the Editor of Science: In reference to Professor Cady's paper on "The Theory of Longitudinal Vibrations in Rods having Internal Losses" in the *Physical Review* for February, I should like to say that we have made in the laboratory of Clark University during the last ten years a very great many measurements of transverse vibrations of rods of all sorts of materials and that we find that the theory of viscosity is by no means substantiated. Until Professor Cady's experimental results are published I shall therefore have to reserve my opinion as to the application of this theory to longitudinal vibrations.

I would say in justice to myself and my students that our results have been held back so long because we have attempted to apply the theory of elastic hysteresis to the subject and the difficulties in the solution of the Volterra integro-differential equations involved have been so great that we have not been able to finish the theoretical results. It looks at present as if that theory was not substantiated either. Accordingly, it will be necessary to invent a new theory or a combination of both. I have now decided to publish the experimental results without waiting for the theory and they may be expected to appear soon in the *Proceedings* of the National Academy of Sciences. The subject is an extremely interesting one and of great importance for many reasons.

Arthur Gordon Webster

Clark University, July 13, 1920

THE EXPLORATION OF VENEZUELA

To the Editor of Science: With three companions, I have just returned from a collecting trip in western Venezuela, and I found there some conditions which will probably be of interest to others who may contemplate a scientific trip in the tropics.

At the present time in western Venezuela there is considerable activity in oil development, not only in exploration, but in the establishment of permanent camps and refineries. Two of these camps are located in country entirely different in character. Arrangements could be made by any one desiring to visit these camps to make them his headquarters, thus rendering accessible for study faunas and floras which the student could otherwise reach and study only at considerable trouble and expense.

One of these camps is about twenty miles from Maracaibo in a desert region. The flora and birds here would be of especial interest.

The other camp is located on the Rio Oro, a tributary of the Catatumbo, and is reached by launch from Encontrados, a town about ninety miles from the mouth of the Catatumbo, which town can be reached by steamer without change of boat from Maracaibo. This camp is in a well watered and heavily forested region, as I was told, but I did not have an opportunity to visit the camp myself.

The camp near Maracaibo belongs to the Caribbean Petroleum Company, with offices at Maracaibo. The other camp belongs to the Columbian Petroleum Company, and letters of inquiry relative thereto might be addressed to Mr. David Brullenbourg, Encontrados.

I was informed by several gentlemen connected with both petroleum companies that any one interested in the fauna and flora of the region would be welcome at these camps, and his expenses there would be reduced to the minimum. These camps offord an oppor-

tunity of living in health and safety in regions where such considerations are of vital importance. Maracaibo can be reached from New York City by the Red "D" Line in from ten to twelve days, and once at Maracaibo, the camps can be reached without difficulty.

In addition to these permanent camps, there is more or less exploration going on, and I was informed by two gentlemen that scientific investigators would be welcome with such exploring parties. Correspondence relative to this matter might be addressed to Mr. Grady Kirby and Mr. J. Whitney Lewis, care of The American Consul, Maracaibo. The Lake Maracaibo region offers an available field to collectors, and there are well-established and regular lake steamer lines, and from Encontrados, to mention only one of the railroads, a railroad extends to Estacion Tachira at the foot of the mountains at an elevation of 364 meters. Between the terminals of this railroad are two or more other points in desirable country for study and collecting. From Estacion Tachira there is an automobile road to San Cristobal, which is on one of the head waters of the Orinoco river.

E. B. WILLIAMSON

MATHEMATISCHE ZEITSCHRIFT

IN view of the numerous reports of the present hardships of German scientists it may be of interest to note that in 1918 a new journal devoted to mathematical research was started in Germany under the title *Mathematische Zeitschrift,* and that three volumes of this periodical appeared in 1919 while only two volumes were expected to be published annually according to the announcement.

This evidence of activity in mathematical research seems to reflect an optimism which one might not have expected under present conditions. The subscription price of the first four volumes of this journal was 24 marks per volume, for the fifth volume it was raised to 32 marks, and for the sixth it was again raised to 48 marks. The director of the journal is L. Lichtenstein, of Berlin.

G. A. MILLER

SCIENTIFIC BOOKS

Aids to Forecasting. By E. GOLD, F.R.S. Published by the Air Ministry. London, 1920.

This publication officially numbered Geophysical Memoir No. 16, gives a classification of the Daily Weather charts, 1905 to 1918. The weakness of any such classification is, of course, the assumption that like surface isobaric conformations are always followed by similar weather conditions.

The general principle which Colonel Gold uses in selecting 15 types and subtypes, recognizes the position of the anticyclone as the dominating feature. This we are glad to notice because for many years forecasters have centered their attention on the "low"; naturally enough, overlooking the fact that directive force and course of the "lows" are determined largely by the antecedent or adjacent "highs." Doubtless we shall have better forecasts for the North Atlantic seaboard when there is a fuller knowledge of the relation between advancing "lows" and those quick moving anticyclonic areas from the north known as "Labrador highs."

This series of British charts starts with the anticyclonic to the S.W. then moving east until over Western Europe, then S.E., E., N.E., N., N.W., and W.

Additional charts of special character are included, such as the indefinite area of low or high pressure, the trough, the dumb-bell depression and the depression centrally situated. The types were selected primarily with reference to the weather of southeastern England and northeastern France.

The forecaster fits his chart to the classified type and finds in a table corresponding type dates. Referring to the charts for those days he studies the general results. It is suggested that a local forecaster ought to have a set of synoptic charts interleaved so that he may study the weather in more detail.

The primary purpose of the arrangement is to assist in day-to-day forecasting; but the data can be employed in discussing from

a statistical standpoint the weather associated with different types.

Colonel Gold mentions the work of Captain Brunt during the war, showing the relation between the amount of low clouds in Flanders at different hours and the general direction of the wind. It appears that with the westerly type there was decreasing cloudiness.

The scheme of indexing, tagging and classifying pressure charts is of course, not new. Odenbach, Brandenburg and others have made classifications for limited areas in the United States, and Bowie and Weightman for the whole country, giving with much detail the storm paths.

Some of the notes made on the different types are extremely interesting: Thus, type I. is very favorable for west winds at night; and a notable instance occurred during the battle of Cambrai, November 20, 1917; the transitional type of fair weather in the evening and inland fog in the morning, occurred on March 20, 1918, when the Germans began their great offensive. Evidently the German forecasters picked the hour. And again May 27 to 31, 1918. Type III. is one that worries the forecaster, for squalls come when he expects fair weather. He forecasts rain in front of the trough and gets fair weather in front and rain behind. On August 26, 1916, seven British airplanes failed to return because of a squall coming from the west while the planes were over the German lines. A different type occurred in June, 1917, during the battle of Messines, for which a week's fair weather was accurately forecast. Type IX. means unpleasant weather. "The most noticeable example in history of this type," says Gold, "is the one which persisted for the first three days of August, 1917, during the battle of Ypres." Type VI. is the typical fair weather anticyclonic type. This type prevailed at the time of the German offensive in March, 1918, and also immediately after the armistice.

It is evident that the forecaster from now on takes his place in all military councils for both offensive and defensive operations.

A. M.

SPECIAL ARTICLES

LINKED GENES IN RABBITS

THE so-called "English" rabbit possesses a dominant pattern of white spotting. A homozygous English mated with non-English rabbits produces heterozygous English young exclusively. These mated with non-English rabbits produce equal numbers of English and non-English young. Facts such as these show conclusively that the English pattern is dependent upon the inheritance of a single Mendelian gene. I have recently discovered that the gene in question is linked with another gene, that for intense *vs.* dilute pigmentation. Dilution is a recessive character alternative with intense pigmentation. Intense pigmentation is seen in rabbits of the varieties, gray, black and yellow. Dilute pigmentation is seen in blue-gray, blue, and dilute yellow rabbits.

Summary of	(1) Eng. Int.	(2) Non-Eng. Dil.	(3) Eng. Dil.	(4) Non-Eng. Int.
Oct., 1919.....	5	6	4	4
Feb., 1920.....	6	9	6	4
June 1920.....	9	10	5	5
July, 1920.....	3	3	1	3
Total.......	23	28	16	16
	Non-crossovers		Crossovers	

In a certain experiment, I crossed a black English rabbit with a blue non-English rabbit. A male from this mating was black English in appearance, but from his parentage was known to be heterozygous both for English and for intensity. He was subsequently mated with blue non-English females, which of course would be homozygous for the recessive member of each of the two character pairs. If no linkage occurred between the two pairs of characters, young would be expected of four classes all equally numerous, viz., (1) English intense, (2) Non-English dilute, (3) English dilute, and (4) Non-English intense. Classes (1) and (2) would represent the original, non-crossover groups, classes (3) and (4) would represent novel, crossover groups. In a series of matings ex-

tending over more than a year, the following numbers of young have been obtained.

The non-crossover classes have consistently been in excess of the crossover classes. In a total of 83 young, 32 have shown crossover groupings of the two pairs of characters, and 51 have shown non-crossover groupings. This is 38.5 per cent. crossovers, an indicated linkage strength of 23 on a scale of 100.

In a previous paper I have shown that English pattern is allelomorphic with Dutch pattern, or very closely linked with it. If English is linked with dilution, Dutch also must be linked with dilution. Attention should now be turned to the question whether other characters of rabbits belong to this same linkage group, and whether other linkage groups can be detected in rabbits.

W. E. CASTLE

BUSSEY INSTITUTION,
July 24, 1920

THE FAT-SOLUBLE A VITAMINE AND XEROPHTHALMIA[1]

IT is generally admitted by those who have conducted feeding experiments with rats that although the essential dietary factors for growth, including the so-called water-soluble B, are present, the animals will not grow to maturity with out the fat-soluble A. The work of Osborne and Mendel, McCollum and associates, Drummond, Steenbock and associates, and others give abundant evidence of this fact. All investigators are not in accord, however, that a positive lack of the fat-soluble A is the direct cause of the eye condition in the rat which McCollum[2] designated as xerophthalmia, some considering this disease to be primarily infectious.

Bulley[3] has recently taken the most definite stand that this eye condition is not due to a dietary deficiency but primarily to infection, resulting from poor hygienic surroundings and uncleanliness. She based her conclusions on a study of some 500 rats that were fed on definite synthetic rations.

In our laboratory we have had occasion to feed white, and black and white rats on various synthetic rations and in going over our records we have compiled data bearing upon the prevalence of xerophthalmia in relation to the known presence or absence of the fat-soluble A. These results are given in the table below.

Group	Vitamines Absent from Ration	Number of Rats Reported	Positive Cases, Xerophthalmia	Per Cent. Positive Cases
A	Fat-soulable *A*	122	120	98.3
B	Water " *B*	103	..	None
C	None (controls)	216	..	"

It is seen that out of 122 rats, Group A, 120 of them or 98.3 per cent. showed sooner or later positive signs of xerophthalmia, and that when the fat-soluble A vitamine was present, with or without the water-soluble B (Groups *B* and *C*), none of the 319 rats showed evidence of this eye ailment. All the rats were fed individually in practically every case. They were kept in metal cages, without any bedding, which were provided with a special removable wire screen floor. The cages, and the food and water cups were always disinfected once or twice a week. The sanitary conditions were, therefore, good. The same assistants handled and fed all the rats so that the attention given them was the same for all and the possibilities of infection from this source was uniform.

It would seem to us that if xerophthalmia was primarily infectious and due to the poor hygienic conditions, that some of the rats in Groups *B* and *C* would certainly have developed it. Further, repeated attempts were made to transmit the disease by using sterile threads of gauze, passing them cautiously over the edge of the lids of the sore eyes, and then carefully inoculating the eyes of the other rats. These tests were negative, as were the controls. This was fairly good evidence that the disease could not be transmitted by this means.

Treatment of advanced cases of sore eyes with a saturated boric acid and also with a

1 Read before the American Chemical Society, St. Louis, April, 1920.

2 McCollum, E. V., and Simmonds, N., *Jour. Biol. Chem.*, 1917, XXXII., 29.

3 Bulley, E. C., *Biochem. Jour.*, 1919, XIII., 103.

silver protein solution failed to relieve the condition. However, when as little as 1 to 2 per cent. of an extract containing the so-called fat-soluble A vitamine was added to the ration, the eyes were speedily cured and the rats increased in weight, indicating that this extract was a specific cure for xerophthalmia.

We therefore agree with McCollum, that xerophthalmia is primarily a dietary deficiency disease, due to a lack of the fat-soluble vitamine. The certainty of the prevalence of the disease depends on the high purity of the essentials that enter into the ration, and on the length of time of feeding, younger animals showing the symptoms much sooner than older ones.

Acknowledgement should be made of the assistance rendered by Miss Marguerite Sturtevant in carrying on this project.

A. D. EMMETT

BIOLOGICAL RESEARCH LABORATORY,
PARKE, DAVIS & COMPANY,
DETROIT, MICH.

THE AMERICAN CHEMICAL SOCIETY

THE fifty-ninth meeting of the American Chemical Society was held at St. Louis, Mo., Monday, April 12, to Friday, April 16, 1920. The council meeting was held on the 12th, a general meeting on the 13th, both in the morning and in the afternoon, divisional meetings all day Wednesday and on Thursday morning, and excursions Thursday afternoon and Friday. Full details of the meeting and program will be found in the May issue of the *Journal of Industrial and Engineering Chemistry*. The registration was slightly over one thousand, eight hundred and twenty-five enjoying the smoker.

General public addresses were given by Paul W. Brown, editor and publisher of "America at Work," on "The Physical Basis for the Economical Development of the Mississippi Valley," by Chas. H. Herty on "Victory and its Responsibilities." The chief public address was given in the assembly room at the Central High School on "Chemical Warfare" by Colonel Amos A. Fries, director of the Chemical Warfare Service.

The following divisions and sections met: Agricultural and Food, Biological, Industrial Chemists and Chemical Engineers, Organic, Pharmaceutical, Physical and Inorganic, Rubber and Water, Sewage and Sanitation Divisions and the Dye, Leather and Sugar Sections. Further details of their meetings will be found in the May issue of the *Journal of Industrial Chemistry*.

The banquet, held on Thursday evening, April 15th, filled the large banquet hall of the Hotel Statler. Excursions to Laclede Gas Works, Monsanto Chemical Works, East St. Louis plant, and Laclede-Christy Clay Products plant, automobile tour for ladies to parks, Art Museum, Washington University, Missouri Botanical Garden and tea at Bevo Mill and excursion to Standard Oil Refinery, Wood River, Ill., and Illinois Glass Company, Alton, Ill., were enjoyed by all.

A general business meeting was held on Tuesday morning, at which resolutions on the death of Professor Alfred Werner were read by Dr. Chas. H. Herty. Ernest Solvay was unanimously elected an honorary member of the society.

CHARLES L. PARSONS,
Secretary

GENERAL PROGRAM

Tuesday, April 13

10 A.M.

Address of welcome: HON. HENRY W. KIEL, mayor of St. Louis.

Response: DR. W. A. NOYES, president, American Chemical Society.

General Addresses

The chemical industry and legislation: HON. E. P. COSTIGAN, tariff commissioner.

Victory and its responsibilities: DR. CHAS. H. HERTY, editor, *Journal Industrial and Engineering Chemistry*.

General Meeting

The prediction of solubility: J. H. HILDEBRAND.

Selenium oxychloride a neglected inorganic solvent: VICTOR LENHER. Selenium oxychloride is a liquid whose properties have hitherto been almost wholly neglected. The raw material, selenium, is at present a waste by-product from the electrolytic refining of copper. From the crude material selenium oxychloride can be produced at a very low figure and by the most simple chemical procedure, the actual procedure being to bring in contact selenium dioxide and selenium tetrachloride in carbon tetrachloride solution. Its chemical properties are such that it will probably prove a valuable reagent to the chemist. It is an excellent

solvent for many of the inorganic oxides which are commonly considered to be very refractory in character. Molybdenum trioxide, for example, can be readily separated from the oxide of tungsten. The solution of molybdenum trioxide in selenium oxychloride shows a deep indigo blue color when exposed to bright light, the solution again becoming colorless when placed in the dark. The reagent is an excellent solvent for unsaturated organic substances. The unsaturated hydrocarbons and aromatic hydrocarbons dissolve readily in the solvent while the paraffin hydrocarbons do not. Bakelite, redmanol, the waterproof insoluble casein glue used in airplane construction, pure rubber, vulcanized rubber, asphalt and bitumen, dissolve with ease. The bituminous material can be dissolved from soft coal, leaving a carbonaceous residue. The vegetable oils mix readily with the reagent while with raw linseed oil a rubber-like mass is formed, quite similar to that produced by the action of chloride of sulphur on certain oils. The chemical behavior of the reagent is quite selective. Many inorganic oxides are completely insoluble in it, while others dissolve with ease, making possible many separations. Metallic sodium is not acted on by the reagent, even at 175° C., while with metallic potassium a violent explosion takes place.

Studying plant distribution with hydrogen ion indicators: E. T. WHERRY.

Adsorption of alkaloids: G. H. A. CLOWES.

The chemical resources of the St. Louis district: O. H. PIERCE.

DIVISION OF PHYSICAL AND INORGANIC CHEMISTRY

Wm. D. Harkins, *chairman*

H. N. Holmes, *secretary*

Wednesday and Thursday

A new form of active nitrogen: GERALD L. WENDT and A. C. GRUBB. This form is produced by the corona discharge at 20,000 volts from a fine wire through pure nitrogen at atmospheric pressure. Under most favorable circumstances as much as four per cent. of the nitrogen is transformed into an active form which reacts readily with hydrogen to form ammonia; with oxygen to form oxides; and with lithium, sodium, potassium, magnesium, aluminium, iron and zinc to form nitrides, and with sulfur to form a sulfide. It is probably different from Strutt's nitrogen in that the latter gave neither ammonia nor oxides of nitrogen. Whether it is atomic or an ozone form has not been determined, but on account of its extreme stability the latter is more probable. It forms very slowly in the discharge and persists for hours afterwards, unlike the ozone forms of oxygen and hydrogen. It has a distinct odor resembling formaldehyde.

The ozone form of hydrogen at atmospheric pressures—the formation of ammonia: GERALD L. WENDT, A. C. GRUBB and ROBERT S. LANDAUER. The ozone form of hydrogen has now been prepared by three methods—the action of alpha rays, in the vacuum electrical discharge, and in the corona at atmospheric pressure. Attempts to produce activation by means of Schumann light failed. The ozone hydrogen, or hyzone, is extremely unstable, reverting to the usual inactive form in less than a minute. Figures are given in a detailed study of the formation of ammonia from the hyzone and nitrogen, activated nitrogen and ordinary hydrogen, active nitrogen and hyzone, and mixtures of the two plain gases activated together and reacting in the corona.

New determination of the absolute value of the radium: uranium ratio: S. C. LIND and L. D. ROBERTS.

A general theory of chemical reactivity, calculations of reaction velocities, equilibrium constants and vapor pressures: S. DUSHMAN and IRVING LANGMUIR.

The direct combination of nitrogen and chlorine: W. A. NOYES and GEORGE H. COLEMAN.

The causes and prevention of after-corrosion on the bores of firearms: WILBERT J. HUFF.

The binary system, Akermanite-gehlenite (lime, magnesia, alumina, silica): J. B. FERGUSON and A. F. BUDDINGTON.

The system Fe_2O_3-SO_3-H_2O: E. POSNJAK and H. E. MERWIN. This paper treats the general equilibrium relations in this system from 50° to 200° and comprises the determination of the compositions and properties of the solid phases, as well as the compositions of the solutions in equilibrium with the various solid and vapor phases within the above temperature range.

The ionization of strong electrolytes: JAMES KENDALL.

Changes in the analytical ratios of sugars during refining: A. F. BLAKE. The clerget sucrose value for sugars, as pointed out by Browne at the Cleveland meeting, normally exceeds the polarization by about one third the percentage of invert.

This is true of raw sugars as shown by numerous analyses, but in the products of a refinery, soft sugars and syrup, the value of the ratio SP/I is very low. Analyses of sugars at all intermediary stages of refining are given, in order to determine where the changes takes place. It is concluded that some change takes place during defecation and filtration of low test material and in the handling of the muds and scums, but that by all means the principal cause of the reduction of the value of this ratio is boneblack filtration. The factor is strongly negative for the first material coming off the boneblack, but increases in following portions until in the last portions it is about equal or slightly exceeds material going on. The average of all material going on is much higher than the average coming off. Since boneblack absorbs invert from first material and gives it up to later material it is supposed that by selective action it might absorb more levulose than dextrose. This is proved by tests on invert sugar. A high value of the ratio in refined products indicates inversion during refining. Losses of sucrose figured upon clerget values exceed those figured on polarization.

Heats of vaporization: J. H. MATHEWS.

Vapor pressure of lithium nitrate-ammonia system: R. O. E. DAVIS, L. B. OLMSTEAD and F. O. LUNDSTRUM. A number of substances known to be soluble in liquid ammonia were subjected to the action of a stream of dry ammonia gas, and several were found to liquefy and form a solution. This property is well known for ammonium nitrate and ammonium thiocyanate, but has not been heretofore reported for several here recorded. Lithium nitrate is one of these. The vapor pressure of solutions of different concentrations of ammonia, lithium nitrate and water were determined. As the solution is non-corrosive to iron and has a low vapor pressure around zero and over an atmosphere at about thirty-five degrees, it is suggested that it may be utilized for absorption of ammonia from a mixture of gases and the subsequent recovery of the pure ammonia.

Vapor pressure of ammonia-calcium nitrate system: R. O. E. DAVIS, L. B. OLMSTEAD and F. O. LUNDSTRUM. Calcium nitrate forms a solution with ammonia similar to that formed by lithium nitrate. The vapor pressure is somewhat lower and the ammonia absorbed is not quite so great. This solution is also non-corrosive, but becomes corrosive as carbon dioxide is dissolved in it.

Magnetic properties of dilute solutions of certain metallic oxides in silicate glasses: R. B. SOSMAN and H. S. ROBERTS.

Pressure measurements of corrosive gases. The vapor pressure of nitrogen pentoxide: FARRINGTON DANIELS and ARTHUR C. BRIGHT. A new all-glass manometer is described in which a platinized glass diaphragm is arranged to close an electrical indicating circuit. A measured air pressure is thus balanced against the unknown pressure without the aid of optical systems. A convenient method for preparing pure nitrogen pentoxide is given. Determinations of the vapor pressure of nitrogen pentoxide up to an atmosphere are presented. They were obtained by a static method in which corrections were made for the decomposition occurring in the gaseous phase.

The formation of ozone and nitric acid from air in the high frequency corona: F. O. ANDEREGG.

Electrometric titration of iodides and a practical potentiometer for such work: W. S. HENDRIXSON. Hydrogen iodide is titrated in 2-normal sulfuric acid with standard permanganate. Sharp end points are obtained and the method seems accurate. Other oxidizing substances and also interfering substances are discussed, and further work is in progress. The potentiometer is a long tube-form rheostat, contact wound with oxidized resistance wire. The beam carrying the slide contact is graduated in millimeters; the instrument has been calibrated, and measurements with it and with a standard potentiometer show practically identical results.

The existence of the nucleus of the meta-hydrogen, the possible presence of meta-hydrogen in hydrogen, and the evidence which indicates that the elements magnesium, silicon, nickel, copper, zinc, and other elements of the atomic numbers from 28 to 80 (mercury), are mixtures. The function of binding and cementing electrons: WILLIAM D. HARKINS.

Welding thermo-couples in the electric arc: JAMES C. MCCULLOUGH. Base metal thermocouples may be welded in a 15 ampére electric arc providing oxidation of the wires is prevented by directing a stream of illuminating gas against the arc.

The solubility of helium: HAMILTON P. CADY, HOWARD MCKEE ELSEY, EMILY V. BERGER. The authors found the absorption coefficient of helium to decrease steadily with rising temperature from 0.00938 at 2° to 0.00836 at 30°. The only previous series of measurements was made by Estreicher, who found a minimum at 30°, but Anthropoff showed that Estreicher had omitted a correction which changed his solubility nearly 100

per cent. in some cases, and shifted the minimum to 10°. The authors find no evidence of a minimum at 10° and that Estreicher's results are about 65 per cent. too high and the recalculated ones from 16 to 93 per cent. too high.

Washing in hard water in the presence of colloidal organic hydrosols: I. N. Kugelmass.

Mineral oil-soap jellies as a foundation for greases: Harry N. Holmes.

A photometric method for the study of colloids and some applications to gelatine: S. E. Sheppard and Felix A. Elliott.

Protoplasm and fuller's earth: G. H. A. Clowes.

On colloidal absorption: the heterogeneous equilibrium between colloids and ions: A. Mutscheller. The subject matter of the paper consists of two parts; the first is experimental and the second part is theoretical. The experimental data given are those of changes caused by the addition of zinc sulphate in increasing concentrations to uniform solutions of gelatine. The experiments performed are on (1) The migration velocities of the ions; (2) the changes of the concentrations of the anions and cations; (3) the velocity of motion of colloidal particles; (4) the surface tension of the solutions; (5) the viscosity of the solutions; (6) the swelling of gelatine. The conclusions from these experiments are compared with the process of ion adsorption by oil drops as studied by Millikan and from the kinetic theory and Einstein equation, adsorption equations of the type generally employed (H. Freundlich & C. G. Schmidt) are derived. Various types of adsorption and the general properties of colloids are reviewed as expressed by the equations derived. (1) Swelling, (2) Hofmeister series, (3) Valency rule, (4) the exponent, (5) the constant and temperature coefficient.

A new form of hydrogen electrode apparatus: Felix A. Elliott and S. F. Acree.

Preliminary note on the use of the hydrogen electrode for measuring the separate ionization constants of polyacids and bases; specifically tartaric acid: Felix A. Elliott and S. F. Acree.

The use of the hydrogen electrode in measuring the ionization of acid salts: Felix A. Elliott and S. F. Acree.

A surface condensation error in certain measurements of vapor pressure by the gas current saturation method: Alan W. C. Menzies. The condensation of saturated water vapor on the surface of not too drastically steamed and washed glass-wool, and also asbestos, was investigated under conditions arranged to parallel as closely as possible those that have obtained in the case of many published investigations in which the gas current saturation method was employed. The results indicate that certain annoying irregularities, which, indeed, appear to have led some investigators to abandon their work by this method, become completely explicable if the importance of this neglected source of error is fully realized.

The explanation of the Tammann-Schottky-Partington anomaly: Alan W. C. Menzies. Tammann found values, by the gas current saturation method, for the dissociation pressure of salt hydrates from 2 to 5 per cent. higher than Frowein had found by the tensimetric method. Partington by new measurements confirmed Tammann's anomalous results, in harmony with Schottky's finding that the initial readings in tensimetric measurements are higher than the equilibrium readings. Explanations of the anomaly by Tammann, Nernst, Campbell, Partington and Brereton Baker are discussed. Mindful of notorious precedent in the case of Charles II. and the Royal Society of London, the author re-examined the facts experimentally, and found that the real facts exhibit no anomaly.

A differential thermometer: Alan W. C. Menzies.

The crystallization of glass: a surface phenomenon. The repair of crystallized glass apparatus: Albert F. O. Germann.

The separation of the element chlorine into chlorine and meta-chlorine: William D. Harkins and C. E. Broeker.

A force, apparently due to mass, acting on an electron, and the non-identity of isotopes in spectra and other properties: William D. Harkins and Lester Aronberg.

A study of the system ammonia, magnesium, mercury: Albert G. Loomis.

The influence of pressure on the electrolytic conduction of aqueous solutions: Ralph E. Hall.

A new form of portable standard cell: C. J. Rottmann.

Hydrous oxides: II. Hydrous aluminum oxide: Harry B. Weiser.

Factors determining the degree of reversibility of precipitation of colloidal hydrous oxides: Harry B. Weiser.

Spontaneous evaporation: Harry B. Weiser and Everett E. Porter.

Negative surface energy: William D. Harkins and Y. C. Cheng.

The formation of ammonia from nitrogen and hydrogen in the corona: William D. Harkins and A. Morton.

The electrical conductivity of dilute aqueous solutions of the alkali hydroxides: Merle Randall and C. C. Scalions.

The partial molal volume of the constituents in solutions of electrolytes: Merle Randall.

A revision of the atomic weight of antimony. Preliminary report: H. H. Willard and R. K. McAlpine.

A separation and volumetric determination of cobalt: H. H. Willard and Dorothy Hall.

A new form of filtering crucible: H. H. Willard.

Notes on the determination of chromium as chromic oxide: Wm. H. Blanchard.

The preparation of colloidal selenium: Victor E. Levine.

A theory of catalytic action: Chas. W. Cuno.

Radiation and chemical reactivity: Eric K. Rideal. The radiation theory of chemical physical action as developed by Trausy Marcelin Price and more recently by Mc. Lewis, Bernouilli and Perrin, in the light of the Rutherford Bohr atomic structure offers a tangible interpretation for the mechanism of chemical and physical change; calculation from radiation data leads to results for the latent heats of evaporation; electrode potentials and heats of reaction of various elements and compounds in close agreement with experimental results. Catalytic action on the radiation theory admits of various interpretations as to the possible modes of mechanism; these are briefly described and answered.

Quantitative measurement of fluorescence: L. J. Desha. The radiation from a mercury arc in quartz tube, separated from most of the visible rays by a glass screen of the "Uviol" type, is allowed to fall upon solutions contained in the cups of the Kober nephelometer. Fluorescent substances emit light which may be compared in the eye piece as in nephelometry. Solutions containing one half to two parts of quinine sulphate per million in normal sulphuric acid yield readily comparable results which are almost if not quite directly proportional to the concentrations. Applications as an analytical procedure are suggested. The work is being continued.

Some applications of sodium peroxide in analytical chemistry: W. M. Sternberg. Some applications of sodium peroxide to analytical processes in particular fusions of lead and zinc ores in iron crucibles have been studied. The decomposition is very rapid and complete in every case. When the usual proportion of sodium peroxide to ore (5 to 8 times the weight of the ore) has been used. If smaller amounts of the peroxide be taken the reaction in case of sulphide ores is rather violent. The results in case of lead ores were uniform but low unless the standard solution has been standardized against a standard ore run by the fusion method. The procedure consisted in fusion one half gram ore in an iron crucible with about 3 to 4 grams of sodium peroxide, dissolving the melt in water, adding 0.7 gram oxalic acid to reduce the lead peroxide. The solution was acidified with sulphuric acid boiled, cooled, lead sulphate filtered and washed with 5 per cent. sulphuric acid. The impure lead sulphate was dissolved in ammonium chloride, or ammonium chloride-sodium acetate mixture, heated to boiling and titrated with ammonium molybdate. In the case of zinc ores the peroxide fusion was dissolved in ammoniacal ammonium chloride solution heated to boiling, filtered and washed with hot ammonium chloride solution, acidified with hydrochloric acid, heated to boiling and titrated with potassium ferrocyanide, after the addition of 50 c.c. of hydrogen sulphide water. Here also good results have been obtained if the solution has been standardized against the standard zinc ore D, or against zinc oxide, both fused and treated in the way described.

Charles L. Parsons,
Secretary

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

Friday August 20, 1920

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE COOPERATIVE COURSE IN ELECTRICAL ENGINEERING AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

For the past year the Massachusetts Institute of Technology and the General Electric Company have conducted a cooperative course in electrical engineering, which has proved unusually successful. In this course, a logical working out of the underlying principles has led to several interesting innovations in the conduct of the work. In brief the scheme is as follows:

The course covers a total of five years, the first two being identical with the regular course in electrical engineering at the institute, the last three being divided between instruction in theory at the institute and practise at the Lynn works of the General Electric Company. The instruction at the institute during the first four years of the cooperative course is similar in method and content to the general course in electrical engineering at the institute with certain omissions and abridgments for which equivalents are provided at the works. The work of the final or fifth year comprises postgraduate research work and training in design. Training at the works is also conducted with a primary view to its educational value and is closely correlated with the instruction in theory. During the final year of this course considerable latitude may be exercised by the students in the selection of their line of work, assignments being made either to shop management in the works' office or to research in the company's research laboratories, depending upon the aptitudes and preferences of the individual students.

The schedule of the cooperative years, *i. e.*, the last three years, is as follows:

The year (12 months) is divided into four three-month periods, the students spending

alternately thirteen weeks at the Lynn works of the General Electric Company and eleven weeks at the institute followed by a two weeks' vacation. Compensation is paid by the General Electric Company to students in this course at an hourly rate which considerably more than pays for their tuition. For a successful completion of the course, the institute confers the degrees of Bachelor of Science and Master of Science.

The educational concept upon which the course is founded combines the rudiments of Spencer's theory of education with the central idea of Josiah Royce's. It is an endeavor to develop simultaneously all the desirable sides of an engineer's mind, character and body and at the same time inculcate in him the spirit of loyalty to his life's work. The course was planned so that these several activities are carried on uninterruptedly throughout the cooperative period. Thus, throughout those periods spent at the works as well as those at the institute, instruction is given in theory, classes are conducted in some humanistic study, time is given and facilities provided for collateral reading, and arrangements are made for systematic physical exercise and recreation. The change therefore, at the end of each period, does not mean so much a change in occupaton as a change in the subjects upon which greatest emphasis is laid.

To facilitate the carrying out of these ideas, the General Electric Company has provided a club house where all the students are housed during their sojourn at Lynn. Here classes in theory of electrical engineering and general studies are conducted. Here the men get to know the full meaning and value of teamwork in play and cooperation in business. Life here is very much like that of a small fraternity with its opportunities for quiet study and recreation. A small library is provided consisting of a collection of technical books and works of interest to the engineer, and also of nearly one hundred volumes from the Lynn Public Library upon more general subjects and in divers fields of literature.

Everything at the club house tends to lessen the sense of separation from the institute and to make the men feel that they still have a part in the activities and student life at Technology. In the works, the students are also made to feel the controlling presence of the institute. On three or four days each week, a member of the staff of the electrical engineering department of the institute spends a half day at the plant in the various shops and offices in which the students are assigned. The student is thus ever conscious of the supervision which the institute exercises over his work even in the shop.

It is in this particular method of supervision, that the Technology cooperative course differs from others. The General Electric Company is doing some real cooperation in the training of manufacturing engineers. The company recognizes that for three years these students are placed in its plant for the prime purpose of being educated and trained as electrical engineers of a particularly high grade and specially informed in manufacturing practise. It has been clearly understood that these students are in the shops and offices to learn and learn thoroughly manufacturing methods. Because he can best obtain this knowledge by actually doing the work himself, and because the skill which he attains in any process is the only fair indication of his knowledge of that process, the student is put on the company's pay roll and becomes a part of its organization. The length of time spent in each of the work's departments is regulated not by the needs of that department but by the value of the experience to the students. As soon as it is deemed that a student has sufficient knowledge of the details in one department he is changed to another. The cooperative students work as earnestly and consistently as the other men in the various departments, as is shown by the reports from the foremen. They are graded on the amount and quality of the work which they do in the various shops and thus the inducement to do good work is as strong in them as in the regular workmen. This spirit of genuine cooperation on the part of the cooperating company, it seems to me, is a fundamental contribution which the Tech-

nology cooperative plan offers to engineering education.

The officials of the company confess that they expect to be the gainers by this policy. Already there is an abundant evidence that their hopes will be realized. The students have been thrown together in a very intimate relationship at the club house and have developed an intense loyalty to one another and to the course which they are pursuing.

There remains to be mentioned the effect which this plan of study has upon the mental condition of the student and upon his progress in acquiring theoretical knowledge. The members of the instructing staff who have come in contact with these students on their return from Lynn are almost unanimous in reporting that they show an increased mental alertness, a greater fund of information concerning all matters connected with their profession, and a wider interest in things in general. That the General Electric Company considers this educational experiment a success is evidenced by the fact that they have raised next year's limit of forty to sixty students. The fact that the applications for next year's class are five times as great as they were last year is some indication of how nearly the course has met the students' anticipations.

Thus, although the plan has been in operation for one year only, it has already gained the approval of the three parties most vitally concerned: the students, the institute, and the cooperating company.

William H. Timbie
Massachusetts Institute of Technology

PARALLEL MUTATIONS IN THE OSTRICH

The account by Dr. A. H. Sturtevant of a mutation (notch) in *Drosophila funebris* similar to one which has occurred several times in *D. melanogaster* recalls the following sentence in Darwin's "Origin," p. 179: "As all the species of the same genus are supposed, on my theory, to have descended from a common parent, it might be expected that they would occasionally vary in an analogous manner."

The problem of parallel mutations has lately been impressed upon one by certain conditions met with in the two-toed African ostrich, *Struthio*. Four species of the genus have been described, among which the most distinctive are the North African ostrich, *S. camelus* Linn., and the South African, *S. australis* Gurney. Owing to a recent importation by the Union Government of South Africa of over a hundred specimens of the northern bird which have been placed in charge of the writer a unique opportunity has presented itself of studying the northern and southern ostrich side by side and also of observing the behavior of their characters in cross-breds.

Well-marked characters separate the two species. The most important are: a difference in size, especially as regards the length of the legs and neck; a different skin coloration from the chick onwards, culminating in a conspicuous contrast between the cocks at the nuptial season; a bald patch on the head of the northern bird, that of the southern being covered with short, hair-like feathers; and differences in the size and shape of the egg, accompanied by a pitted surface in the one and an ivory smoothness in the other. The characters represent germinal differences, those of the imported birds being retained under the new environmental conditions and reappearing in all the progeny which have been hatched. The birds cross freely and in the first generation hybrids (F_1) the bald patch is found to be dominant, appearing in all the hundred or more crosses reared, while the dimensions and colors of the body and the features of the egg appear as intermediates of varying degree. Sufficient time has not intervened for the rearing of many second generation hybrids, (F_2) only two having yet been obtained. They however give every reason to expect that segregation of the characters will take place in the second generation. In whatever manner this may occur there can be no

[1] "A Parallel Mutation in *Drosophila funebris*," Science, July 19, 1918.

question that the specific features are the expression of distinct factorial differences in parts of the germ plasm of the northern and southern ostrich.

Like most of the Ratitæ the two-toed ostrich is degenerate in some respects and highly specialized in others, compared with ordinary flying birds. Degeneration is especially indicated by the small size of the wings and the practical absence of feathers from their under surface and specialization (degeneration) by the reduction in the number of toes. The development and progress of ostrich farming in South Africa had produced prior to the war about a million domesticated birds which afford an abundance of living specimens for examination, now supplemented by the importation already mentioned as well as by much embryological material. The result has been the demonstration that the ostrich is undergoing slow degeneration in numerous directions in connection with its plumage, wings and legs, survivals of practically all stages in the process being procurable.

The principal directions along which plumage degeneration is taking place include the general under-covering of the wings, the single row of under-coverts, the remiges or wing quills, the second and higher rows of upper-coverts, the feathers covering part of the leg and the under-covering of down. The third digit of the wing exhibits important evolutionary stages, while in addition to the loss of the first, second and fifth toes of the foot it can be shown that the small fourth is also in process of disappearance, particularly as regards its claw. Losses of the scales over the big middle toe reveal that retrogression has already begun on what will in time be the only remaining toe. In any individual bird the changes in any one direction take place quite independently of those in the other directions, and all proceed in a definitely determinate manner which is the same for all the representatives of the two species. The experiments already carried out serve to establish that the losses are factorial in their nature and that in crosses they follow strictly Mendelian lines. They are to be regarded as retrogressive mutations resulting from the dropping out of factors, the changes proceeding in regular succession along various directions, the succession being particularly impressive in the case of the gradual loss of plumes from certain of the rows of feathers and in the digits of the foot (*rectigradations* Osborn[2]). It is highly questionable if up to the present any selection value can be attributed to any of the changes.

The present interest lies in the fact that the mutative changes are common to the germ plasm of both the northern and the southern ostrich and are taking place in one independently of the other. They may indeed be presumed to be the same throughout the continent, suggesting that they are intrinsic in their nature and independent of environmental influences. If we regard the two species of ostriches as distinct then we can understand how the term parallel mutations may be applied to the changes going on in both, but at the same time it may appear to carry with it the notion that similar mutations are proceeding in two disconnected and independent germ plasms. If, on the other hand, we retain the idea of the origin of species from a common stock which Darwin had in his mind in the quotation given, then it becomes more in harmony with fact to think of the changes as taking place in germ plasm of the same nature and of a common genetic origin.

We must conceive the germ plasm to be fundamentally the same for the African ostrich as a whole, though certain changes have taken place in parts of it which give us the differences delimiting the species. On this view it is easy to comprehend how the same mutative changes will occur in what for the sake of convenience we now distinguish as two species. The mere fact that one assemblage of ostriches is bald-headed, larger and differently colored as compared with another and that the hens lay a different egg indicates only slight differences in the germinal make-up of the birds. In both the constituents of the

[2] *Amer. Nat.*, August, 1917.

germ plasm controlling the plumage and the structural details of the wings and legs remain unchanged, and it is in these that we have similar degenerative changes in progress. In studying the small differences which distinguish species we may overlook the main essentials in which they agree.

The individuality and separability of the germ factors in the ostrich are well exemplified in the fact that while differential changes have taken place in some respects common changes have taken and are taking place in other respects. We may respectively designate as parallel the mutation found in the two species of *Drosophila* and the numerous ones met with in the two species of *Struthio,* because they occur in different species, but it must be with the understanding that the changes proceed in similar parts of the germ plasm which are common to both, and would go on were there no specific differences.

Whether parallel mutations ever occur in germ plasms not genetically related may well be doubted. It may be that similarity of changes always implies similarity of origin in corresponding parts of the germ plasm. There is abundant evidence that the fourth, outer toe of the ostrich is well on the way towards disappearance, and when this is effected we shall have only the single middle toe in two such widely separated animals as the ostrich and the horse. While to institute a close comparison of the limbs of the two animals seems to strike at the roots of our morphological ideas it may well be that the degeneration in the toes of *Struthio* is an expression of changes in its germ plasm of a fairly similar nature to those which have been effected in the germ plasm of *Equus,* and is referable to separable parts of the germ plasm which the two have or had in common. All that this involves however is the recognition of the fact that the fundamental parts of the limbs of digitate vertebrates take their origin from corresponding parts of the germ plasm common to all. Osborn[3] must have had occurrences of this kind in mind when he wrote: "Similar rectigradations may arise in all the descendents of similar ancestors at different periods of time; they always give rise to parallelism or convergence between the members of related phyla." To go beyond digitate limbs, we may presume that the characteristics of the chordate phylum—dorsal tubular nervous system, notochord, visceral arches and clefts—arise from separable parts of the germ plasm which are common to all the members of the phylum, and distinct from other parts which give rise to the characters serving to distinguish the classes of the chordates.

[3] *Amer. Nat.,* April, 1915.

In whatever way we conceive the germinal changes to be going on in the two-toed ostrich it is clear they are not limited to the African genus *Struthio* among the flightless birds. For we have degenerative changes of a fairly similar nature represented in the three-toed American ostrich (*Rhea*) and in the wing of the New Zealand *Apteryx,* while the *Moas* had apparently lost their wings altogether before becoming extinct. Where exactly similar, these may be termed parallel mutations, but it seems more in harmony with modern genetical ideas to think of them as taking place in separate parts of the germ plasm which the sub-class has in common. In the Ratitæ as a whole we seem to have one of those groups of animals, so often represented in the evolutionary series, in which high specialization in certain directions is accompanied by marked decadence in other respects and which in the end result in extinction. When they are alike the changes may be described as parallel mutations, but it is sought to emphasize that they take place in a similar manner in those parts of the germ plasm which the group has genetically in common.

Though the living representatives are so widely separated, the germ plasm controlling the plumage, wings and legs of the Ratitæ as a whole is manifestly subject to some common intrinsic influence which expresses itself in the gradual loss of these structures, the process proceeding more rapidly in some than in others and sometimes modified in different ways. Many of the facts of degeneration presented by the ostrich incline one to attribute

the changes to a slow reduction of factorial potency, culminating in complete factorial loss. While in by far the majority of forms of life the germ factors are static, may there not be others in which certain of the factors are increasing in potency and some in which they are dwindling?

J. E. Duerden

Rhodes University College,
Grahamstown, South Africa

SCIENTIFIC EVENTS

CENTRAL HEADQUARTERS FOR BRITISH CHEMISTS

At a dinner held in honor of Lord Moulton on July 21, Sir William Pope announced that a public appeal was about to be made for funds for the erection of central headquarters for British chemistry. According to a statement in *Nature* none of the chemical bodies has the accommodation for a meeting of more than two hundred persons, or adequate library space. The Chemical Society conducts its business at Burlington House, Piccadilly, in rooms provided by the government nearly fifty years ago, when the membership was about one fifth of what it is to-day. The Institute of Chemistry possesses a good building in Russell Square, completed during the first year of the war, but it is barely adequate for the present activities of the institute, which has to look to colleges for hospitality for any general meeting of unusual interest and for lectures. The Society of Chemical Industry and the Society of Public Analysts hold their meetings at the Chemical Society's rooms. Neither of these bodies nor any other which is concerned with chemistry, such as the British Association of Chemical Manufacturers, the Faraday Society, the Biochemical Society, and those devoted to the various branches of technology—brewing, dyes, glass, ceramics, iron and steel, non-ferrous metals, leather, concrete, petroleum, and so forth—possesses accommodation to compare with the spacious halls and headquarters of the Institutions of the Civil, the Mechanical, and the Electrical Engineers, and of the Royal Society of Medicine.

The appeal, which will be made by the Federal Council for Pure and Applied Chemistry, on which practically all the chemical interests of the country are represented, has the cordial support of Lord Moulton, who, as director-general of the explosives supplies, ministry of munitions repeatedly acknowledged the services rendered during the war by these scientific, technical, and industrial bodies.

The scheme, which aims at providing under one roof, so far as is practicable, a common meeting place, library, and editorial facilities for technical journals, is highly desirable, and indeed imperative, as a matter of supreme importance to the welfare of the whole country in relation to questions of defence and the maintenance and development of all branches of industry and commerce which depend on the applications of chemistry. The sum required for building is estimated at £250,000; a similar sum is required for establishing a chemical library and to provide for the compilaton and production of works of reference in the English language.

FORESTRY EDUCATION

The British Empire Forestry Conference, which met in London during July adopted the following resolutions on forestry education, which the delegates are to bring to the notice of their respective governments:

It should be a primary duty of forest authorities throughout the empire to establish systematic schemes of forest education. It has been found, for climatic and other reasons, that it would not be possible for each part of the empire to establish a complete scheme of forestry education of its own, and therefore it is essential that those parts of the empire which are willing and able to establish complete systems should, as far as possible, frame such schemes with a view to combining for meeting the needs of those parts which can only themselves make a partial provision for their requirements. Part of this subject has been dealt with by a committee, whose report, which refers mainly to the higher training of forest officers, is approved by the conference. The main principles embodied in this report are as follows:

1. That one institution for training forest officers be established in the United Kingdom.

2. That students be selected from graduates hav-

ing taken honors in pure or natural science at any recognized university.

3. That it be an integral part of the work of the institution to arrange supplementary courses at suitable centers for students requiring special qualifications and also special courses for forest officers from any part of the empire, whether at the institution or at centers of training in other parts of the world. The governments should recognize these courses as part of the ordinary duties of the forest officers, at any time during their service, and the governments concerned should give special facilities to forest officers in their service to attend such courses.

4. That a department of research into the formation, tending, and protection of forests be associated with the training institution.

5. That encouragement should be given to the existing provision made by universities and colleges for forestry instruction for those who do not desire to take the full course suggested for the forestry service. It appears that this is especially applicable to the United Kingdom. It is also desirable to make adequate provision for woodmen's schools for the training of foresters as distinct from those which are intended for forest officers.

SCHOLARSHIPS IN MEDICAL SCHOOLS

ACCORDING to the *Journal* of the American Medical Association 348 scholarships are reported this year in the following thirty-eight medical schools:

University of Alabama School of Medicine, Mobile	67
Leland Stanford Junior University Medical School*	3
University of California Medical School,* San Francisco	3
University of Colorado School of Medicine,* Boulder	1
Yale University School of Medicine,* New Haven, Conn.	2
Hahnemann Medical College and Hospital of Chicago*	6
Loyola University School of Medicine, Chicago.	3
Rush Medical College, Chicago	7
University of Illinois College of Medicine,* Chicago	7
Indiana University School of Medicine, Indianapolis	12
State University of Iowa College of Medicine.	1
University of Kansas School of Medicine*	17
Johns Hopkins University Medical Department, Baltimore	6
University of Maryland School of Medicine,* Baltimore	6
Harvard Medical School,* Boston	30
Boston University School of Medicine*	50
Detroit College of Medicine and Surgery	8
Washington University Medical School, St. Louis	4
Dartmouth Medical School,* Hanover, N. H.	2
University of Buffalo Department of Medicine*	1
University of Cincinnati College of Medicine.*	12
Western Reserve University School of Medicine, Cleveland	1
University of Oregon Department of Medicine,* Portland	3
Hahnemann Medical College and Hospital of Philadelphia*	12
Jefferson Medical College of Philadelphia	2
Temple University Department of Medicine, Philadelphia	3
University of Pennsylvania School of Medicine,* Philadelphia	4
Woman's Medical College of Pennsylvania,* Philadelphia	24
Medical College of the State of South Carolina, Charleston	8
University of Tennessee College of Medicine, Memphis	14
Vanderbilt University Medical Department, Nashville, Tenn.	4
Baylor University College of Medicine, Dallas, Texas	5
University of Texas Department of Medicine,* Galveston	1
University of Wisconsin Medical School*	6
University of Vermont College of Medicine*	1
Medical College of Virginia, Richmond	10
University of Virginia Department of Medicine,* Charlottesville	2
Total in 38 medical schools	348

Besides the twenty-one colleges marked by an asterisk in the above list which have loan funds for deserving but needy students, such funds are available also at the six following medical schools:

College of Medical Evangelists, Loma Linda, Calif.
Tulane University of Louisiana School of Medicine, New Orleans, La.
University of Missouri School of Medicine, Columbia, Mo.

University of Nebraska College of Medicine, Omaha, Neb.

Wake Forest College School of Medicine, Wake Forest, N. C.

University of North Dakota School of Medicine, University, N. D.

CHICAGO MEETING OF THE AMERICAN CHEMICAL SOCIETY

The fall meeting of the American Chemical Society will be held with the Chicago Section, September 6 to 10 inclusive. The preliminary program assures a meeting which you can not afford to miss. The Chicago Section, by far the largest west of the Alleghenies, is arranging details of entertainment in their usual vigorous manner and one of the largest and most interesting meetings ever held is surely in view. Let every member who can be present.

Registration will begin during the morning of September 7 at the Congress Hotel. Information Bureau will be located at the hotel, and competent guides will be stationed at all the railroad depots. Tickets for the banquet, smoker and excursions will be obtained at the registration desk. Please give the matter of registering and obtaining tickets your first attention, as this will render our hosts a courtesy that will be appreciated. Tuesday afternoon a special registration desk will be placed in the Northwestern University Gymnasium.

The general program is as follows:

Monday, September 6

12.30 P.M.—Luncheon to the directors and advisory committee of the American Chemical Society by the directors of the Chicago Chemists Club.

4 P.M.—Council meeting.

6.30 P.M.—Dinner to the councilors by the Chicago Section.

8.15 P.M.—Council meeting resumed.

Tuesday, September 7

10 A.M.—General meeting of the society, Gold Room, Congress Hotel. Registration during the morning.

Addresses of Welcome—Dr. Julius Stieglitz, Honorable chairman of the convention and a representative of the Chicago Association of Commerce.

Response—President W. A. Noyes.

Two main addresses of thirty minutes each, one by a prominent local business man and the other by a scientist of national standing.

1.15 P.M.—Entrain for Evanston.

3.15 P.M.—Continuation of general meeting of the society in the Northwestern University Gymnasium.

Addresses—"Relation of educational institutions to the industries," Professor H. P. Talbot. "Some uses of silica gels," Professor W. H. Patrick.

4.30–10 P.M.—Combined men and ladies entertainment and reception, garden party, and beach party, including outdoor picnic dinner and smoker, band and orchestra concerts and organ recital, swimming, dancing, singing, sports and a special evening program.

Wednesday, September 8

9 A.M.—Divisional meetings at the University of Chicago.

12–2 P.M.—Luncheon at the Edelweis Gardens.

2 P.M.—Excursions—to Sherwin Williams Paint Co., Carter White Lead Co., Libby, McNeil and Libby Canning Plant, Pullman Car Co., Doehler Die Casting Co. Assemble at Van Buren St. Station of I. S. at 2.

6.30 P.M.—Alpha Chi Sigma Dinner.

8 P.M.—Presidential address: "Chemical Publications," Professor W. A. Noyes.

Thursday, September 9

9 A.M.—Divisional meetings, University of Chicago.

12–2 P.M.—Luncheon.

2 P.M.—Divisional meetings.

4 P.M.—Meeting of chairmen and secretaries of local sections.

7 P.M.—Banquet at Congress Hotel.

Friday, September 10

Excursions to Geary Iron Foundries Co., Fansteel Co., Lindsay Light Co., Carnotite Reduction Co., National Malleable Castings Co. (number limited). Others to be announced.

Titles for papers should be first sent to the secretary of the appropriate division or section and not to the secretary of the society. Titles to appear on the final program must be in the hands of the individual secretaries not later than August 21. The following are the

addresses of the divisional and sectional secretaries:

Divisions:

Agricultural and food chemistry: T. J. BRYAN, 4100 Filmore St., Chicago, Ill.

Biological chemistry: A. W. DOX, cr. Parke, Davis & Co., Detroit, Mich.

Dye section: R. NORRIS SHREVE, 43 Fifth Ave., New York, N. Y.

Fertilizer chemistry: H. C. MOORE, 209 W. Jackson Blvd., Chicago, Ill.

Industrial and engineering chemistry: H. E. HOWE, Marine Biological Laboratory, Woods Hole, Mass.

Organic chemistry: ROGER ADAMS, University of Illinois, Urbana, Ill.

Pharmaceutical chemistry (medicinal products chemistry): EDGAR B. CARTER, 2615 Ashland Ave., Indianapolis, Ind.

Physical and inorganic chemistry: H. N. HOLMES, Severance Chemical Laboratory, Oberlin, O.

Rubber chemistry: ARNOLD H. SMITH, Goodyear Tire & Rubber Co., Akron, Ohio.

Water, sewage and sanitation: W. W. SKINNER, Bureau of Chemistry, Washington, D. C.

Sections:

Leather chemistry: WILLIAM KLABER, 613 North Third St., Newark, N. J.

Sugar chemistry: FREDERICK J. BATES, Bureau of Standards, Washington, D. C.

Members who are to read papers having a popular appeal are requested to send synopses of them for the use of the A. C. S. News Service, care of American Chemical Society, 1 Madison Ave., Room 344, Metropolitan Bldg. (Tower) New York City, which, in cooperation with the local publicity committee, will conduct the press room. A short abstract (about 100 words) should be sent with the title of papers or handed to the secretary of your division at the time of presentation, so that it may appear in SCIENCE, if you wish your paper to have publicity or to obtain priority through this publication.

The final program will be sent about September 1 to all members who before August 29 have signified their intention of attending the meeting; to the secretaries of sections; to the council; to members of the Chicago Section, and to all members making special request therefor by mailing a postal card to this office direct.

CHARLES L. PARSONS,
Secretary

1709 G STREET, WASHINGTON, D. C.

SCIENTIFIC NOTES AND NEWS

DR. GEORGE ELLERY HALE, director of the Mount Wilson Observatory, has been elected one of the twelve foreign members of the Società Italiana delle Scienze, in succession to the late Lord Rayleigh.

PROFESSOR RAYMOND PEARL, of the Johns Hopkins University, has been decorated by the King of Italy as Knight of the Crown of Italy.

A MARY KINGLSEY medal has been awarded by the Liverpool School of Tropical Medicine to Ch. Wardell Stiles, of the United States Public Health Service, for his work on the eradication of hookworm disease.

SIR W. J. POPE has been elected an associate of the section for the mathematical and physical sciences of the Royal Belgian Academy.

THE first gold medal given by the Institution of Sanitary Engineers was presented at the annual summer meeting of the institution to Major A. J. Martin "for his services in originating health week and in the development of civil and military sanitation before and during the war."

MR. G. W. MOREY, of the Geophysical Laboratory, Carnegie Institution of Washington, who has been on leave of absence in charge of the optical glass plant of the Spencer Lens Company of Buffalo, N. Y., since November, 1918, has returned to his research work at the laboratory.

MR. M. J. PROFFITT, formerly of the Great Western Sugar Company, Denver Colorado, has been put in charge of sugar technology at the Bureau of Standards.

MR. FRIEND LEE MICKLE, bacteriologist of the Bureau of Laboratories of the Connecticut State Department of Health, has been appointed director of laboratories for the Bureau of Health of Atlantic City, N. J.

Dr. Waldemar T. Schaller has severed his connection with the Great Southern Sulphur Co., Inc., of New Orleans, La., and has returned to the United States Geological Survey, Washington, D. C.

Professor Charles J. Chamberlain, of the University of Chicago, has been invited to deliver a lecture on Cycads before the Botanical Section of the British Association for the Advancement of Science. He goes as the guest of the association, which meets at Cardiff, Wales, on August 24.

Professors L. E. Dickson, of the University of Chicago, and L. P. Eisenhart, of Princeton University, have been elected delegates of the American section of the International mathematical union to attend the meeting of the union at the University of Strasbourg beginning September 18, 1920.

Dr. F. Burt Wolbach, of Harvard Medical School, who has been abroad for six months in an effort to establish definitely the organism causing typhus, has returned to the United States.

Dr. Arturo Garcia y Casariego, assistant professor of pathologic anatomy and histology of the School of Medicine of the University of Havana, has been designated by the government to make a trip abroad to study matters relating to the teaching of these subjects. Dr. Gillermo Díaz y Macias, professor of practical pharmacy, has been commissioned to study the organization of pharmacologic laboratories abroad.

The Harveian Oration of the Royal College of Physicians, London, will be delivered by Sir Frederick Andrews on October 18; the Horace Dobell lecture by Sir William Leishman on November 2; the Bradshaw lecture by D. R. C. B. Wall on November 4; and the FitzPatrick lectures on the History of Medicine by Dr. E. G. Browne, of Pembroke College, Cambridge, November 9 and 11.

It is stated in *Nature* that the Rayleigh Memorial Committee has decided that the memorial to the late Lord Rayleigh in Westminster Abbey shall take the form of a mural tablet to be erected near the memorials to Sir Humphry Davy and Dr. Thomas Young. The execution of the tablet will be entrusted to Mr. Derwent Wood. It is expected that after all expenses are met there will be a balance remaining, and this the committee proposes shall be used to establish a library fund at the Cavendish Laboratory, Cambridge, with which Lord Rayleigh was closely associated.

Dr. Walter Faxon, in charge of mollusca and crustacea in the Museum of Comparative Zoology of Harvard University, from 1886 until about five years ago, and previously assistant professor of zoology at the university, died on August 10. Dr. Faxon graduated from Harvard College in the class of seventy-one.

The death is announced of Professor Felix Guyon, a former president of the Paris Academy of Medicine, head of the Hôpital Necker and known for his work on the diseases of the urino-genital organs.

The *Bulletin* of the American Mathematical Society announces the following deaths among mathematicians: Professor P. van Geer, on October 3, 1919, at the age of seventy-eight years; Professor M. Haid, of the Karlsruhe technical school, on November 15, 1919; Professor A. Boersch, at Homburg; Professor R. Heger, at Dresden, at the age of seventy-three years; Professor Paul Stäckel, of the University of Heidelberg, on December 13, at the age of fifty-seven years; Professor R. Malstroem, of the department of mechanics at the technical school at Helsingfors.

The United States Civil Service Commission announces for September 21, 1920, an open competitive examination for Naturalist on the Steamer *Albatross* in the Bureau of Fisheries at $2,200 a year with a possible bonus of $20.00 a month. Competitors are not required to report for examination at any place but will be rated on education, experience and thesis or publication. Further information may be obtained by application to the Civil Service Commission, Washington, D. C.

A first-hand study of Alaskan reindeer and land fur-bearing animals is now being made

by Dr. E. W. Nelson, chief of the Biological Survey, United States Department of Agriculture, and several specialists belonging to the staff of the bureau. Dr. Nelson will spend from two to three months in Alaska, while the other specialists will be in Alaska under permanent appointment acquiring information which will be valuable in the administration of new duties assigned to the Department of Agriculture by recent acts of Congress, namely, the improvement of reindeer herds as a source of meat in the Territory, fox farming, and the protection of land fur-bearing animals. One of the men accompanying Dr. Nelson—Dr. Seymour Hadwen—was formerly connected with the health of animals branch of the Canadian department of agriculture. He and a new member of the the staff, formerly connected with the Alaska Reindeer Service of the Department of the Interior, are devoting their attention to diseases among the reindeer. Two other members of the party, formerly grazing examiners with the Forest Service, are investigating the grazing areas of Alaska to determine the regions best suited to the reindeer.

The timber on the Tongass National Forest in Alaska is said in a report issued by the United States Forest Service to be of particular importance in connection with the paper situation. It is estimated that there are about seventy billion board feet in Sitka, spruce and western hemlock well suited for paper making. The timber is located in a comparatively narrow belt along some 1,200 miles of coast line. Water power is available, as is also deep water transportation from numerous mill sites. It is estimated that the cut from this region alone would insure a perpetual supply large enough to meet one half of the present newsprint requirements of the United States. Alaska is one of the centers to which the newsprint industry of the United States should look for a large future development, says the report. The same is true of centers in the west where immense resources of pulp wood supply are now almost wholly undeveloped. Much of this timber is in the national forests. To bring about properly the development of the pulp and paper industry in new regions of abundant timber supplies the report recommends a comprehensive survey to furnish exact information upon the stand and location of suitable timber and other needed data.

In connection with the meeting of the American Ornithologists' Union in Washington, D. C., this year, the local committee plans to hold an exhibit showing the history and development of zoological illustration as applied to birds, including original drawings, paintings and photographs. The pictures, which may be mounted on cards, but not framed, will be exhibited under glass in the Library of Congress where the exhibit will be held together a month or more. So far the consensus of opinion is that to keep the exhibit within bounds, each artist shall be limited to original drawings or paintings and each photographer to 2 prints.

An advisory council for the Board of Surveys and Maps was organized, at a meeting held in Washington, Monday, July 12, to serve as an agency through which the Board can reach the map-using public and the public offer suggestions or criticisms regarding the work of the various bureaus of the Federal Government engaged in making surveys and maps. The Board of Surveys and Maps has greatly increased the cooperation between the different government bureaus and has established a central office from which information may be obtained regarding any map published by any government bureau. It remains for the public to utilize the facilities offered in the same spirit of cooperation. The advisory council consists of twenty or more representatives of the various national engineering, scientific, and map-issuing associations of the country who are interested in improving the efficiency of the government map-making agencies and the character and usefulness of the maps produced. It is hoped that suggestions of unmet needs, improvements in technique, or ways in which the government maps and engineering information can be made more useful to the map-using citizens

of the country will be sent to the officers of the Council, Edward B. Mathews, chairman, National Research Council, or A. G. Seiler, secretary, Touring Bureau, A. A. A., Riggs Building, Washington, D. C.

THE annual meeting of the Society for Extending Rothamsted Experiments was held on June 18 at Rothamsted, Harpenden. Mr. J. F. Mason presided. It was reported by Dr. E. J. Russell, director, that the work of the station had again become normal. The staff was now complete, and operations active in all departments. The staff of the station at present numbers 70, and there are large laboratories and a 300-acre farm. The Ministry of Agriculture has now asked that the station shall undertake the study of the diseases of plants, and although the work has been begun the present facilities are quite inadequate. It is proposed to buy an adjoining site to build there a special laboratory for this work. For this £4,000 is needed, and half will be provided by the government. The remainder has to be found privately, and a fourth of the amount has already been subscribed.

ACCORDING to an Associated Press despatch an expedition fitted out by the Swedish Society of Anthropology and Geography of Stockholm has left Yokahama to make a scientific survey of the peninsula of Kamchatka. The work will last for at least two years. The members of the expedition are from the University of Stockholm and are under the direction of Even Bergman. They are prepared for a zoological, botanical ethnographical, geological and geographical survey of the whole peninsula. The collections will be donated to the Swedish Geographical Society and to the University of Stockholm. Kamchatka is known to have a rich and varied flora and fauna, but it is comparatively unknown to scientists. The plant life is particularly interesting, as it is unusually extensive for the high latitude, and many of the forms belong to regions much farther south. Birds and animals are numerous, and as far as known are similar to those of Alaska.

UNIVERSITY AND EDUCATIONAL NEWS

THE Harvard University School of Medicine has received $350,000 from the Rockefeller Foundation for the development of psychiatry, and $300,000 for the development of obstetric teaching.

MR. M. DOUGLAS FLATTERY, an American, has presented the Institute of Bacteriology at Lyons with 100,000 francs for an annual scholarship for a student who will specialize in laboratory work on the bacteriology of infectious diseases.

AT the University of Minnesota Dr. W. H. Hunter has been appointed professor of chemistry and acting head of the division of organic chemistry; Dr. C. A. Mann, professor of industrial chemistry and acting head of the division of industrial chemistry; Dr. G. H. Montillon, associate professor of industrial chemistry, and Dr. R. E. Kirk, of Iowa State College, assistant professor in general chemistry.

DR. DANIEL STARCH, of the University of Wisconsin, has become associate professor of psychology in the school of business administration at Harvard University.

PROFESSOR JAMES NEWTON MICHIE, assistant professor of mathematics in the Agricultural and Mechanical College of Texas, has been appointed adjunct professor in the department of applied mathematics at the University of Texas.

P. W. BOUTWELL, assistant professor of agricultural chemistry at the University of Wisconsin, has been appointed associate professor of chemistry at Beloit College.

W. J. FULLER, assistant professor of civil and structural engineering of the University of Wisconsin Extension Division, has recently resigned to accept a position on the engineering staff of the Government Institute of Technology at Shanghai, China.

THE *Bulletin* of the American Mathematical Society states that at the University of Berlin, Professor L. E. Brouwer, of the Univer-

sity of Amsterdam, has been appointed professor of mathematics; Professor R. von Mises, of the Dresden technical school, has been appointed professor of applied mathematics, and Dr. Issai Schur has been promoted to a full professorship of mathematics. Professor C. Carathéodory has resigned, to accept a professorship at the National University of Athens.

DISCUSSION AND CORRESPONDENCE

EFFICIENCY IN THERMAL CALCULATIONS

THERE is something wrong with the commonly accepted definitions used in calculating efficiency when applied to thermal phenomena.

Take the following case as an example. An ice-making machine is placed in a room that requires heating. Let us calculate the efficiency of the operation of heating the room. Assuming the machine to be operated by an electric motor, the heat supplied to the room consists of two parts, the heat equivalent of the electric current, and the heat withdrawn from the water in making ice. As the entire machine is located in the room, there are no losses, all friction being utilized as useful heat. We therefore have a case where the useful heat is greater than the heat we paid for, or an efficiency of over 100 per cent.

For another illustration, consider the heating of a room by an electric heater. The efficiency is 100 per cent., as all the energy of the current goes into the room. But this same current could have been used to run machinery in the room, such as fans, sewing machines, etc., that would have returned all the heat to the room eventually. Should not this additional work be considered in calculating the efficiency of the outfit?

There is one long established law that gives the clue to more suitable definitions of thermal heat units. Carnot established the fact that the efficiency of an ideal heat engine was equal to $(T_1 - T_2)/T_1$ where T_1 equals the absolute temperature of the source of heat and T_2 the temperature of the exhaust. In other words the work that it is possible to obtain from heat depends upon the difference in temperature as well as upon the calories present.

Our efficiency terms would be of more practical value if instead of using the calories we should use a modified heat unit consisting of the calory multiplied by the ratio referred to above, taking the value T_2 as the lowest temperature of the surrounding air, condenser water, etc.

This would, of course, increase the mathematical difficulties, but why say that a boiler has an efficiency of 80 per cent. when but one third of that 80 per cent. can be used by an ideal engine. This method would also bring out forcibly the tremendous losses in heating houses by coal, without making use of the power as a by-product. The inefficiency of the steam locomotive is frequently commented upon, but the inefficiency of raising the temperature of a house 10° F. is so much greater that it should be made evident to all.

There is one serious objection to the use of a ratio such as that of Carnot's cycle as part of a unit of heat. That is, is Carnot's cycle the best possible cycle? None other has been developed as yet, but we have not established the proposition that none can be developed.

ALLAN W. FORBES

WORCESTER, MASS.

IN Mr. Forbes's interesting communication, which the editor has been good enought to let me see, he has perhaps overlooked the fact that in a reversible cycle, the efficiency being defined as the ratio of work done to heat taken in for a motor, always less than unity, if the efficiency of a freezing machine or heating plant be defined as the ratio of heat taken up to work done, this will be the reciprocal of the efficiency of the motor, and consequently greater than unity. Evidently the efficiency will be greater the smaller the temperature interval to be covered. This was pointed out many years ago by Lord Kelvin, who called attention to the enormous waste in heating a house, the difference of temperature employed being that from the red heat of combustion of the coal to the temperature desired, when all that is needed is the small

range between indoor and outdoor temperatures. Lord Kelvin actually proposed to heat a house by a reversed heat engine or refrigerating machine. I am not aware whether this has actually been tried in practise.

By the efficiency of a boiler we mean the ratio of the energy, contained in the hot water and steam into which it has been converted, to the amount of heat that may be realized by burning the coal. This suffices to indicate the performance of the boiler, while that of the engine is a separate thing, and suffices to compare the performance of the engine with that of a perfect engine, limited as it is by the second law of thermodynamics. Mr. Forbes casts doubt upon Carnot's cycle being the most perfect one, but that was thoroughly proved by Carnot to be the case. In fact the gas-engine and the Diesel, which approach most nearly to the Carnot cycle, have the highest efficiency that has been attained. Mr. Forbes is correct in pointing out the fact that the efficiency of electric heating is unity, a fact which interests the consumer, who in this rare case knows that the meter can not do him an injustice, and yet, for all that, this is not a cheap method of heating. Electricity *can* compete with the ice-man.

Arthur Gordon Webster

REVERSAL OF THE SODIUM LINE

To the Editor of Science: On a recent visit to a large plate-glass factory in the vicinity of Charleston, West Va., I had the good fortune to note the reversal of the well-known sodium line "D." The instrument used was a small pocket direct-vision spectroscope, which I carry with me on technical trips.

The furnace was a 200-ton plate-glass type, gas fired; and the reversal was noted at the peep-hole near the charging end, and shortly after the introduction of a fresh charge of the "mix." The reversal was noted in the case of two furnaces, one of these giving a *steady* reversal, and one giving a *wavering* and *intermittent* reversal. The phenomenon was noted both by myself and also by three distinguished technical friends attendant on the trip. Of course the reversal of the sodium lines is frequently observed in the electric arc, but this is the first instance in my experience that I have noted such reversal in a *fuel-fired furnace*. The temperature of the furnace was probably approximately 3,000° F.

The observation may be more common in the experience and observation of others; but if this brief note should prove of value, the writer will be glad to answer any detailed questions regarding this rather unique matter. I have long held the opinion that the spectroscope has not been—and is not yet—used for its full technical worth in the practical arts.

Charles S. Palmer

United Fuel Gas Co.,
Charleston, West Va.

THE CARNEGIE FOUNDATION AND RESEARCH IN THE COLLEGES

In a paper on college government and the teacher's salary, in the 14th annual report of the Carnegie Foundation for the Advancement of Teaching, the statement is made that much of what passes for research in American universities is only imitation research, which is detracting from the quality of the teaching to which the students are entitled. The conclusion is drawn, by inference at least, that the large sums of money spent on this kind of research could be expended much more profitably in strengthening the teaching work. It is unnecessary to debate the correctness of the writer's judgment as to the quality of the research work done in the universities. A large part of the research work done everywhere is mediocre or poor and it would be surprising indeed if this did not imply also to the colleges. No doubt the work done in some institutions is inferior to that of some others just as the teaching is of different degrees of perfection. It seems, however, that the writer has entirely overlooked one aspect of research work which in the colleges should be given the most serious consideration.

For many years the appreciation of the value of research has been growing in this country. This interest has been greatly stim-

ulated by the war and is especially reflected by the demand for investigators by the industries. Obviously, if this interest is to be maintained, if indeed it is not to be seriously checked by unsatisfactory work of poorly trained men, a supply of investigators must be available, and they must come from the colleges. Of course, a student can not be taught to be an investigator. He can only be given the tools of the trade, the essential training in the fundamentals, and the opportunity to make himself into an investigator if he has the proper mental equipment. He must learn first of all that there is such a thing as research by which a livelihood and an honorable position can be gained. Through contact with research workers he must acquire that spirit which is absolutely essential to continued investigation, and without which few young men will choose the laboratory in preference to the more lucrative offerings of the business and professional world. This contact can be obtained only in colleges doing research work. Every one who has had experience in maintaining the personnel of an investigational institution knows that the chances of getting good research men is much greater in the colleges doing research work. Not only does he find there students sufficiently interested in research to consider it as a calling, but those who are temperamentally adapted to this exacting type of work have had some opportunity of demonstrating their fitness. Colleges doing no research work rarely turn out an investigator. It is improbable that the students in these institutions differ essentially from those whence most of our investigators come. The difference lies in the fact that nothing is done to develop those having qualifications for this work. Musicians are not developed in a technical school, nor artists in a college of law.

Presumably research is conducted primarily for the results it may yield, but what we usually consider as the results of university research is in reality but a by-product; the real results are the investigators it develops.

There has never been a time when the colleges were so unable to meet the demand for men to fill research positions. Under these conditions should the Carnegie Foundation attempt to discourage research in the universities, or should it use its great resources and power to strengthen the weak places it has found?

L. A. ROGERS

WASHINGTON, D. C.

RADICALISM AND RESEARCH IN AMERICA

IN a communication by Neil E. Stevens having the title "Radicalism and Research in America" printed in the last issue of SCIENCE, both the title and the purport of the article seem to challenge comment as a form of veiled propaganda such as is all too common at the present time. When radicalism is now pretty clearly identified with bolshevism, I.W.W.ism and other similar yearnings after dictation by the proletariat styled pure democracy, and when these eruptions within the body politic are threatening to overthrow our established system of representative (not democratic) government, the claim is set up through insinuations rather than by direct assertions that the fathers of our government, Washington, Adams, Jefferson, Franklin and Madison, were all radicals identified with such tearing-down movements. It seems further to be implied that because they encouraged science, therefore scientific men need have no fear that such overturns as our radical now propose will be other than advantageous to them.

If I have misinterpreted the purport of the article I trust that Mr. Stevens will explain just what *radicalism* connotes in his communication.

WILLIAM HERBERT HOBBS

ANN ARBOR, MICHIGAN,
July 10, 1920

[Dr. Stevens writes that he does not wish to reply to Professor Hobbs, but that he has no objection to a quotation from a personal letter to the editor in which he says: "I used the word 'radicalism' in what I believed to be its correct sense as established by good usage, as Dr. True uses it in the opening paragraph of his article 'Thomas Jefferson

in Relation to Botany' (*Scientific Monthly*), and as Henry Jones Ford uses it in 'Radicalism in American Poltics' (July, *Yale Review*), in the first paragraph of which he refers to Madison and Franklin as radicals. The word can not possibly be regarded as synonymous with, or identified with, Bolshevism, I.W.W., or anarchy." ED.]

ANATOMICAL LITERATURE

PROFESSOR ERICH KALLIUS (Anatomisches Institute, Breslau, Germany), who has taken over the editorship of the Anatomische Hefte and Ergebnisse der Anatomie und Entwicklungsgeschichte, writes that it is difficult now to obtain foreign literature and that he would be very glad if American contributors would send reprints as freely as possible for the use of these journals.

H. V. WILSON
UNIVERSITY OF NORTH CAROLINA, CHAPEL

SCIENTIFIC BOOKS

Greek Science and Modern Science. A Comparison and a Contrast. By CHARLES SINGER. London, Oxford University Press, 1920, 8o, 22 pp.

This lecture, inaugurating a systematic course on the history of science and of scientific ideas, was delivered at University College, London, on May 12, 1920. Its author, one of Emerson's "monks of Oxford," was a captain in the Royal Army Medical Corps during the recent war. Its object is to bridge over the embarrassing gap between the history of Greek science and that of modern science. It is a commonplace to deride the Middle Ages for sterility in science; the thing is to ascertain just how, where and why they were sterile. This department of historical investigation Singer defines as "the pathology and embryology of human thought"; for, in the Middle Ages, Greek science did slowly and surely die, and strange as it may seem, our modern scientific methods were actually engendered, by lengthy and painful travail, out of medieval restrictions.

Of this view of things, Dr. Singer's lecture gives a clear and intelligible account. The argument is as follows: It is one of the vainest delusions of the modern mind to imagine that we can entirely enter into the modes of thought of the ancient Greeks. This fact, which Singer has frequently insisted upon in private correspondence, was already emphasized long ago in the verses of one who was very close to them, the Roman Lucretius.

> Nec me animi fallit Graiorum obscura reperta
> Difficile inlustrare Latinis versibus esse,
> Multa novis verbis præsertim cum sit agendum
> Propter egestatem linguae et rerum novitatem.

But it is at least reasonably certain that the Greeks based their scientific system upon Egyptian, Minoan and Assyro-Babylonian tradition, that this pre-Hellenic material was an anonymous, socialistic, collectivistic product; while the Greeks thought as individuals, not as a people, stamping their work, each one of them, with his own individuality, thus giving to science the eponymous character which it has since retained. We have only to think of Diophantine algebra, Euclidian geometry, the *corpus Hippocraticum* of Galenical remedies. Credulous and facile of generalization as were the Greeks, they had yet an abiding intuitive conviction that "order reigns in nature"; that behind the observed and observable phenomena there is an ascertainable law which correlates them and is their *raison d'être*. It is just this sense of law in nature and of the necessity for personal scientific investigation that is their most valuable heritage to posterity. This is what Sir Henry Maine meant when he said that "Nothing moves in the modern world which is not Greek." In the Middle Ages, the reckless freedom in speculation as to the causes of things which the Greeks enjoyed was suppressed by prince and prelate as subversive of the feudal theory of the state and of the theological view of the universe. But, in spite of the harm it has done, there was, in Singer's view, a distinct advantage in all this. It got the practical scientific worker away from sterile speculation and down to brass tacks; so that gunpowder, printing, the mariner's compass, spectacle lenses were immediately taken up, and the outcast, outlawed medieval

surgeon was forced to become a more practical bedside man than the top-heavy scholastic internist. The Levitical code of sanitation (isolation of suspects in eight contagious diseases), and Hindu (non Roman) surgery also gained a status. Modern science differs from Greek and medieval science, however, not so much in aims or results, as in processes and methods; and here we have "certain new factors of an order the world has not before seen." Except in the mathematics, the essence of which is to give steps and processes, the Greek scientist gave only conclusions and concealed his proofs, his findings being in the Lucretian phrase "*obscura reperta.*" Concerning this, Singer says (p. 20):

> Ancient mathematics, like everything else that has come down to us from antiquity, have of course suffered from the accidents of time, but the obscuring power of time is a mere light veil compared to that heavy impenetrable curtain that the Greeks have themselves drawn over their biological works.

The medieval scientists (witness the alchemists or Leonardo's mirror-written physiology) had the same tendency. But we pride ourselves upon the fact that our scientific monographs are devoted mainly to definite proofs of the author's propositions. The Greeks had no instruments of precision because, being speculative philosophers, they felt no necessity for proofs. Thus, while mathematics, however interrupted by the Dark Ages, is a scientific continuum, medieval science, like Greek science, is too frequently a solution of continuity, while the continuity of modern science is insured by simple preservation of records. The only danger threatening modern science, as Singer sees it, is in the isolation of scientific workers through the extreme and complex specialization of their subjects, making one branch of science unintelligible to the followers of another. The best way to obviate this danger is through the broad study of the historical evolution of science as such, for this "experimental" method will evade the pitfalls which befell Whewell and Comte, viz., the arbitrary concept of a rigid orthodoxy in science, based upon a quasi-medieval hierarchy of all the sciences. The history of science is not secular or sociological history, but the cultural history of mankind, the bases of which are anthropology and psychology. Through this branch of study we may clarify our own concepts, document and preserve our records, correlate our findings and so establish a continuum with the future and the past.

The finely wrought argument (Singer at his best) concludes with the thought, familiar to us in certain well-known verses of Lucretius, that the distinctive hope and glory of the science of our age is "that it will place in the hands of the inheritors of our civilization and our thought, whoever they may be, an instrument that will enable them to carry on our work from the point at which we leave it." No one can read this inspiring lecture without a heightened, clarified perception of the superior worth of modern science and the dangers which beset it. In the lecturer's own words:

> Our scientific system, of its nature, claims an independence of all race, nationality or creed. It is of all studies the most truly international. The scientific man may, better than most, claim with St. Paul that he is a citizen of no mean city, that he is the true citizen of the world.

F. H. Garrison

Army Medical Museum

SPECIAL ARTICLES

THE PRODUCTION OF ARTIFICIAL HERMAPHRODITES IN MAMMALS

During the last ten years especially, there has been a decided impetus towards the analysis of sexual conditions, in animals, that has largely centered itself around a study of the physiology of the sex glands by means of transplantation experiments. From 1910 to 1913 Steinach reported his remarkable results obtained from sex gland transplantation in which one sex gland had been transferred to young castrated animals of the opposite sex (rats and guinea-pigs). The results in brief were: (*a*) masculinization of female animals by implanted testes (*i. e.*, the young female animal, after receiving the transplant, developed into a male-like animal as indicated

by somatic changes—weight, length, skeletal changes, hair coat—as well as by psychic behavior—temperament, and reactions toward animals of the opposite sex); and (*b*) feminization of young male animals by the implantation of an ovary, with corresponding results.

One point of especial interest, in this work, is in reference to the apparent antagonism of the sex glands (considered as hormone antagonism) when brought together in the same individual. Steinach was unable to obtain either a growth or persistence of an implanted sex gland *unless the gland of the host (gland of the opposite sex) was removed before the implantation was made.*

Following Professor Lillie's study of the free-martin, and at his suggestion, I began in 1916 a study of the interrelation of the sex glands that very soon led to a reinvestigation of the conditions considered by Steinach. In his study of cattle twinning, Lillie found that in a very large percentage of cases the twin fetal circulations are connected through an anastomosis of the allantoic blood vessels, as a result of the fusion of the chorionic vesicles. In correlation with such a condition, and only when the twins were male and female, the ovarian development was suppressed in the female of the pair; also, in many cases, there was an apparent superposition of male secondary sex organs upon the "determined" female sexual condition. In offering an explanation of this unique condition, Lillie suggested the possibility of a hormone antagonism with a dominance of the male secretion[1] (*i. e.*, theoretically a secretion of the testis, carried in the blood from the male to the female of the pair, may be responsible for the accompanying abnormal condition found in the female); the development of the male sexual apparatus suffers not at all from the unusual condition. If the twins are homosexual—*i. e.*, two males or two females—the reproductive system of each is entirely normal.

I have previously reported[2] the progress of the investigation undertaken and have offered a few criticisms of Steinach's conclusions. The immediate cause for this preliminary report, upon other aspects of the problem, is the appearance of a paper by Knud Sand[3] relative to the possibility of obtaining a persistence or growth of both kinds of sex glands in the same host without any apparent ill effect to either gland (a hermaphroditic condition); this paper is practically a summary of a larger monograph published in Danish.

Sand, on the whole, supports the work of Steinach but has reflected some discredit on the idea of sex gland antagonism. In a later paper Steinach reported having succeeded in obtaining subcutaneous growth of both kinds of sex glands *when these were grafted simultaneously on the same infantile castrated male animal*, and Sand, repeating the same technic, obtained an hermaphrodite animal both somatically (both glands persisted, and the rudimentary mammary glands of the male animal underwent considerable hypertrophy) as well as psychically (the animal is described as behaving both as a male and as a female). He also implanted an ovary within the substance of a testis ("Ovario-testis") and obtained a (normal) persistence of both glands. It is difficult, however, to clearly understand all of the statements in this paper, for after describing such a persistence of an ovarian graft within a testis which he claims has been left "in their natural position," he asserts that:

> *Neither did I ever succeed in a real ingrafting of the heterological gland on non-castrated animals*, whereas there was, as mentionel before, a positive result if the gonads had immediately been brought under somewhat the same conditions by simultaneous transplantation on the same animal, or by the intimate union formed by the production of ovario-testes.[4]

Sand also agrees with Steinach in his ideas of psychical changes as a result of gonad transplantation into previously castrated young animals of the opposite sex; he uses as a criterion of sex his interpretations of certain features of the behavior of such an animal.

[1] F. R. Lillie, *Jour. Exp. Zool.*, Vol. 23, 1917.

[2] C. R. Moore, *Jour. Exp. Zool.*, Vol. 28, Nos. 2 and 3, 1919.

[3] *Jour. of Physiology*, Vol. 53, December, 1919.

[4] Italics mine.

In my former papers I have discussed certain factors used as definite indicators of maleness and femaleness, and have attempted to point out the difficulty of properly interpreting the observations. With considerable reticence I was inclined to give some weight to psychical behavior in cases of the most extreme type of reactions; but I wish again to emphasize the absolute unreliability of closely graded indications of psychical behavior of rats and guinea pigs as an indication of their sexual nature. It is, in my opinion, going to an extreme when one asserts as does Sand:

This somatic hermaphroditism was combined with a decided bisexualism of the psycho-sexual character, in that the animal showed, *even during the course of a single hour, momentary change from female to a decided male character*, according to the animals (males, newly-born young ones, females) with whom it was brought into contact.[5]

Sand's general conclusions in reference to sex gland growth seem entirely superfluous in the light of my own results. In explaining his failure to obtain growths of ovarian grafts in *non-castrated infantile* male animals he assumes a rather indefinite type of "Immunity" on the part of the host, towards the implanted tissue, and explains it as follows:

In every organism are found certain substances which are necessary for the sexual glands, and these substances the latter try to obtain to the greatest possible extent. The normally situated non-transplanted gonads have the best chance of being able to absorb these substances, for which reason heterological (perhaps also homological) gonads, transplanted on normal organisms, can not get enough of these substances and therefore perish. Homological and heterological gonads, which have been transplanted at the same time to the same organism, are both able to grow in, having both about the same opportunity of absorbing the substances.

Further the phenomenon that ovaries ingrafted in the testes find good conditions for developing there, can probably be explained by a similar theory, in that the substance of the normal male organism, necessary for the gonads, are perhaps stored up in the testes, both kinds of gonads thus being able to make use of them.

[5] Italics mine.

So far as the persistence and growth of rat gonads is concerned, this theory is entirely unnecessary for I have been able to obtain growths of ovarian grafts, subcutaneously, intra-muscularly, and intra-peritoneally, and without difficulty, in young male rats one of whose sex glands was intact and normal.

This part of my work was begun in 1917 and some animals bearing transplants are still living; but a detailed account of this work is nearing completion and will appear as the third paper of a series "On the Physiological Properties of the Gonads as Controllers of Somatic and Psychical Characteristics."

I have obtained persistence of both types of sex glands grafts after transplantation into young animals of the opposite sex, one of whose sex-glands had been removed to furnish material for other grafts, while the second gland of the host remained undisturbed. In the case of the ovary, the graft, after persisting eight and one half months in a male animal with an intact testis, presents all the features of a normal ovary of similar age excepting corpus luteum tissue and the presence of a larger number of atretic follicles. Normal follicles of all sizes are present—primordial follicles, more mature ones showing the beginning of the follicular cavity, mature follicles, and even those showing polar body formation in the ovum. The follicles seem not, however, to go on in their normal behavior to ovulation and corpus luteum formation, but undergo atresia. The fate of a follicular mass can be traced to its complete conversion into interstitial material. In this behavior of the follicles of the grafts, they are very similar to corresponding structures of the young female sex gland before the age of sexual maturity.

With the testicle grafts the results are not quite so striking due to the fact that mammalian testis transplantations, without exception so far as I am aware, results in the loss of the germinal epithelium. The grafts resemble considerably a cryptorchid testis in that both retain the well-rounded seminiferous tubules, but all that remains of a cellular character are Sertoli cells. The same disappear-

ance of the germinal epithelium, however, has been noted in case of ligation of the vas deferens without further disturbance of the testis. The testis graft does persist after transplantation in a female, with an intact ovary, and it is as normal as autoplastic testicular grafts, either with or without previous castration.

These observations show definitely that a sex gland can be successfully transplanted to an animal of the opposite sex which retains one normal gonad. Positive cases are of much more significance than any number of negative cases and leave no question as to whether the two glands can exist in a functional condition within the same organism at the same time. A male rat with one testis will function as a normal male during the time it is carrying two ovarian grafts as an integral part of its somatic structure; both of these grafts remain essentially normal, showing all grades of maturity of follicles, even after existence, in the subcutaneous tissues of the male, of eight and one half months.

A discussion of these observations will be taken up more fully when the completed work appears.

Carl R. Moore
The University of Chicago

STATIC REJUVENATION

For several years the writer has been making a systematic detailed study of the driftless area of southern Indiana, and has now in preparation a paper on the physiographic development of the Knobstone cuesta region lying between the Muscatatook and Ohio rivers. This particular region offers one or two problems of more than local interest, and the interpretation of one of these will be briefly stated here.

It appears that some time about the middle of the Tertiary the entire region was reduced to a peneplain (Highland Rim, or Lexington peneplain). The region was then rejuvenated by uplift. Dissection of the uplifted peneplain followed. Dissection was fairly complete near the major streams, and, in the regions of soft rocks, local areas were reduced to base-level. These locally reduced plains indicate that the uplift amounted to something like 175 feet. The region was again uplifted and dissection was renewed or continued. The Tertiary uplifted peneplain is now represented by remnants which are as much as 300 to 500 feet above the present local base-level. The New Albany shale and the lower part of the Knobstone areas were reduced to a lowland in contrast to the region west of the Knobstone escarpment. The lowland plain, stretching north from Louisville consists of a flat to undulating plain varying from 430 feet in the valleys near the Ohio River to something like 600 feet in elevation on the low divide between Silver Creek and the tributaries of the Muscatatook River. Since there are a large number of hills and flat interstream tracts at an elevation of about 500 feet at the south and coming up to about 600 feet near the above mentioned divide to the north, it has been stated that a local peneplain was formed at that level.[1] The writer concurs in the belief of a base-leveled plain of local area, and that its further development was terminated by rejuvenation. The rejuvenation, however, was not necessarily brought about by uplift. The dissection of the plain was very likely brought about by drainage changes made near the beginning of the Pleistocene. The present Ohio River is a large stream made up of a number of former drainage basins which were more or less destroyed or deranged by combination into a large major stream approximately skirting the outer limits of glacial advance. A very much smaller stream than the present occupied this territory near Louisville. It was able to reduce the area of soft rocks nearly to base-level, but it had a much steeper gradient than the much larger present Ohio. When the present Ohio invaded the basin of the much smaller pre-glacial stream the local peneplain was statically rejuvenated, due to the sinking of the larger stream into the plain on account of its ability to possess a much lower gradient in its grade condition. Such

[1] Chas. Butts, "Geology of Jefferson Co., Ky.," Ky. Geological Survey, 1915, pp. 201–203.

a rejuvenation is here called *static rejuvenation.*

It may be further stated that the region of the Muscatatook River to the north still possesses just such a local base-leveled plain that existed in the New Albany locality. It is inferred that the stream which the Ohio dispossessed was somewhat near the size of the Muscatatook-White River. This stream possesses a gradient in its graded condition slightly less than one foot to the mile, while the Ohio has a gradient below New Albany slightly less than three inches to the mile. It would appear than such a change in gradient would allow a trenching of something like 90 feet, which is approximately the amount of the dissection of the local peneplain in the vicinity of New Albany, using the flood plain as the present local base-level. This figure is derived by taking the difference between the gradients of the Ohio and its assumed predecessor from New Albany to Cannelton, a distance of approximately 120 miles. In the lattitude of Cannelton valley filling begins to be rather conspicuous, and this nullifies any difference in the gradients of the former and the present streams, assuming that the valley filling of southwestern Indiana and associated regions took place during the pleistocene. A still further check both on the postulated static rejuvenation and its amount is found in the peculiar gradients of the streams emptying into the Ohio between New Albany and Cannelton. The gradients are approximately as high in their lower reaches as in their middle and upper courses. This is conspiciously true of Blue River and Indian Creek. Other complications however, enter into the full explanation of these peculiar gradients, making this a problem in itself.

The above statement of the conditions and such an explanation are ventured here for the first time. It is thought that the principle of static rejuvenation may have a wider application than the case here given. The writer would further suggest that its application be made in certain piracy cases.

CLYDE A. MALOTT

INDIANA UNIVERSITY

THE AMERICAN CHEMICAL SOCIETY. II

COLLOID SYMPOSIUM

W. D. Harkins and Harry N. Holmes, *Joint Chairman*

Some practical applications of colloid chemistry: JEROME ALEXANDER.

Gelatinous precipitates: WILDER D. BANCROFT.

The colloid chemistry of soaps: MARTIN H. FISCHER.

Vegetable tanning as a colloid chemical process: JOHN ARTHUR WILSON. Vegetable tanning is the reaction taking place between the collagen of hide and the water-soluble matter extracted from certain vegetable materials and known as tannin. Collagen is not built up of individual molecules, but of chains of atoms forming a three-dimension network with interstices sufficiently large to permit the passage of all ordinary molecules and ions. Under the conditions obtaining in practise, collagen has a positive electrical charge and the solution absorbed in the interstices has a difference of potential against the unabsorbed portion of the tan liquor. The tannin particles are negatively charged and the thin film of solution immediately in contact with the surface of the particles has a potential difference against the bulk of the tan liquor, but of sign opposite to that in the case of collagen. This surface film of solution and the solution absorbed by the collagen tend, therefore, to merge, and when this occurs, the positively charged collagen and negatively charged tannin neutralize each other by combination, forming leather. The fact of practical importance is that the potential differences referred to, and therefore the rate of tanning, can be altered without necessarily altering the absolute values of the electrical charges.

Ceramic processes associated with colloid phenomena: A. V. BLEININGER. Clays are mixtures of finely divided aluminum silicate, of the type $Al_2O_3 2SiO_2 2H_2O$ with granular matter, such as quartz, feldspar, mica, etc., and other colloids like ferric oxide and hydroxide. The particles are of the magnitude of 5μ, or smaller. Clay suspended in water is affected in a pronounced manner by alkalies, salts and acids. The former tend to deflocculate it, the latter two cause coagulation. Both phenomena occur in phases. Absorption of the basic ion of salts is characteristic, the acid ion remaining in the dispersing medium. Deflocculation is employed in the purification of clays and in the casting process. Measurements of the fluidity

of clay suspensions offer the most convenient means of detecting the change caused by the presence of reagents, though the distinction made by Bingham between viscous and plastic flow must be kept in mind. In the firing of clay, contraction of the external volume takes place due to the effect of surface tension and the lowered viscosity upon heating. With maximum contraction and closing of the pore space the state of vitrification is reached. The mass of the clay itself undergoes expansion upon heating irrespective of the external contraction. The relation between temperature, time and contraction is a most valuable one for expressing the heat work done upon clays and other silicates and oxides. Vapor pressure likewise is a probable factor in the condensation of substances like magnesia, coal, carbon, etc., or in mixtures of inert oxides with those of higher vapor tension. The end result of the heating process tends toward the partial elimination of the colloid and the substitution of the anisotropic phase.

Surface energy: W. D. HARKINS.

Nomenclature in colloid chemistry. A plea for reform: ARTHUR W. THOMAS.

ORGANIC DIVISION

E. Emmet Reid, *Chairman*

Rodger Adams, *Secretary*

Methyl amines from carbinol and ammonium chloride, equilibria involved: W. D. TURNER and A. M. HOWALD. Ammonium chloride and carbinol with and without the addition of fused zinc chloride were maintained at elevated temperatures in steel bombs by immersing in the vapors of constant boiling liquids. The products were analyzed for the three methyl ammonium chlorides, ammonium chloride and carbinol. Using zinc chloride as a dehydrating agent, mono-methyl ammonium chloride was obtained up to 50 per cent. of the ammonium chloride present di-methyl ammonium chloride up to 10 per cent. and tri-methyl ammonium chloride up to 4 per cent. of the ammonium chloride present. The methods of separation and estimation of the four bases are given together with tables of the equilibria reached, a summary of the results obtained and a brief bibliography.

The synthesis and physical constants of benzene and toluene sulphonamides: K. K. KERSHNER and W. D. TURNER. The sulphonamides of benzene and toluene are prepared synthetically from benzene and toluene. This is accomplished by sulphonating the benzene and toluene, forming the sodium salt by the addition of sodium chloride, preparing the sulphonchloride by means of phosphorus pentachloride, and securing the sulphonamide by treatment with concentrated ammonia. Duplications of this process are made and comparative data taken on the yields of the different compounds formed at the conclusion of each step of the synthesis. The sodium salts are purified by centrifuging and by recrystallization from alcohol and the sulphonamides by centrifuging and by recrystallization from both concentrated ammonia and alcohol. Solubility data at different temperatures is taken on the sodium salts of benzene and toluene and on their corresponding sulphonamides with reference to absolute alcohol and pure water. A summary, giving the salient points of the work, and a bibliography, covering the literature on the subject, are given.

A sulphide alcohol: T. C. WHITNER, JR., and E. EMMET REID. By action of ethylene chlorhydrin on sodium salt of butyl mercapton the alcohol

$$CH_3CH_2CH_2CH_2SCH_2CH_2OH$$

is obtained. This alcohol and its esters and halide derivatives have been studied and shown to be quite similar in many properties to the higher alcohols of about the same molecular weights.

A sulphide acid: K. UYEDA and E. EMMET REID. By action of sodium chloracetate on sodium salt of butyl mercapton the acid

$$CH_3CH_2CH_2CH_2SCH_2COOH$$

is formed. This acid is readily obtained and is found to be similar in properties to the parafine acids of about the same molecular weight. The methyl, ethyl, prophyl and butyl esters and a number of salts of this acid have been prepared.

Heterocyclic compounds of n-arylamino alcohols: R. E. RINDFUSZ and V. L. HARNACK. (1) Cyclic nitrogen compounds may be formed by the dehydration of *N*-arylamino alcohols. (2) Where six-membered rings may be so formed, the dehydration takes place closing a side ring into the benzene nucleus. (3) Where a five-membered ring would be formed as a side ring annealed to the benzene nucleus, the preference is to form a six-membered ring outside. This is unlike the behavior of analogous oxygen compounds. (4) The reaction of nitrogen compounds has not been carried out in enough cases to show that these inferences are general.

The automatic separator in organic preparations: I. N. HULTMAN, ANNE W. DAVIS and H. T. CLARKE. Principle of automatic separator. Separation of butyl alcohol or amyl alcohol and water. Steam distillation of aniline and similar liquids. Preparation of anhydrous oxalic acid, butyl ether, butyl oxalate, trimethylene chlorohydrin, and glycerol dichlorohydrin.

Some condensed rings containing arsenic: W. LEE LEWIS and W. V. EVANS. Oxydiphenylene chlor arsine is prepared by a modification of Pope's method condensing diphenyl ether and arsenic chloride in the presence of aluminium chloride. With the Grignard reagent mixed arsines of the type oxydiphenylene ethyl arsine are obtained. The brom, iodo, cyan, sulphocyan and hydrosulphide derivatives were prepared. Chlorination gave oxydiphenylene trichlorarsine which on careful hydrolysis gave the oxychloride. Bromination with subsequent hydrolysis yielded oxydiphenylene arsenic acid and its metal and alkaloidal salts. The condensation of diphenylmethane and diphenyl sulfide with arsenic chloride is being studied.

A cooperative pamphlet on organic chemical preparations: ROGER ADAMS, O. K. KAMM, H. T. CLARKE, J. B. CONANT. An annual pamphlet is to be published containing the detailed directions for the preparation of various reagents which may have been produced in the laboratories in which the above authors work. The directions are to be tested out in one of the other laboratories and not until the results can be duplicated are they to be published. A discussion of the reaction and bibliography of other methods of preparation are included. It is hoped that others who may be carrying on investigations in organic research will be willing to contribute methods of preparation for various reagents which they may have developed in detail in their laboratories. These will be tested out and published with the others.

The reaction between aldehydes and acid halides: ROGER ADAMS, H. E. FRENCH and L. H. ULICH. It has been shown that the reaction between aromatic acid halides and aliphatic or aromatic aldehydes and between aliphatic acid halides and aliphatic aldehydes to give compounds of the general formula RCOOCHXR is very general. Early work in this field showed that a number of aliphatic halides and aldehydes reacted together to give compounds of this type but until the above research was undertaken no substances were obtained between aromatic acid halides and aliphatic aldehydes with the exception of the compounds from benzoyl chloride and formaldehyde and no compounds from aromatic acid halides and aromatic aldehydes were produced with the exception of the compound from benzoyl bromide and benzaldehyde. The reaction between aliphatic acid halides and aromatic aldehydes does not seem to run so smoothly and results are not yet available on this point. These halogenated esters that are produced react in many cases merely like a mixture of the acid halides and aldehydes. In other cases, the halogens react like the halogens in alkyl halides.

The preparation and physiological action of oxazolidones and their decomposition into substituted B-amino ethyl alcohols: ROGER ADAMS and J. B. SEGUR. The oxazolidones are readily produced by condensing phosgene with ethylene chlorohydrin to give beta-chloroethyl chlorocarbonate. This is condensed with aniline to give the corresponding urethane derivative and then by treatment of this latter substance with alkali, the oxazolidone is produced as follows:

$$ClCOOCH_2CH_2Cl \rightarrow C_6H_5NHCOOCH_2CH_2Cl \rightarrow \underbrace{C_6H_5N - COOCH_2CH_2}.$$

If the oxazolidone is treated with excess of concentrated alkali or if the urethane derivative is treated directly with excess of concentrated alkali, very good yields of N-aryl amino alcohols are produced.

$$\underbrace{C_6H_5N - COOCH_2CH_2} \rightarrow C_6H_5 - NHCH_2CH_2OH.$$

The paraethoxy phenyl oxazolidone has about the same toxicity as phenacetin and as an antipyretic possesses slightly greater value than phenacetin.

CHARLES L. PARSONS,
Secretary

(To be continued)

THE NORTH CAROLINA ACADEMY OF SCIENCE

THE nineteenth annual meeting of the North Carolina Academy of Science was held April 30 and May 1, 1920, at the North Carolina State College of Agriculture and Engineering, West Raleigh, N. C. At the same time the spring meeting of the North Carolina Section of the American Chemical Society was held.

Among the more important business matters discussed and acted upon were those relating to the affiliation of the academy with the American Asso-

ciation for the Advancement of Science, the decision of which rests with the executive committee with power to act; and the matter of seeking state support from the next legislature which was left in the hands of the executive committee for action and if found favorable the president was authorized to appoint a committee to approach the legislature in an effort to obtain $1,000 per year to be expended for publications and the furthering of research work.

A total of twenty-eight new names was added to the membership list. The membership now includes 113 individuals interested in science in North Carolina.

The following officers were elected for the year 1921:

President: Z. P. Metcalf, professor of zoology and entomology, State College, West Raleigh, N. C.

Vice-president: J. M. Bell, professor of physical chemistry, University of North Carolina, Chapel Hill, N. C.

Secretary-Treasurer: R. W. Leiby, assistant entomologist, research, State Department of Agriculture and Agricultural Experiment Station, Raleigh, N. C.

Additional members executive committee: H. R. Totten, University of North Carolina; R. N. Wilson, Trinity College; F. A. Wolf, State College, Agricultural Experiment Station.

The meeting was featured by the address of the retiring president, Dr. A. H. Patterson, who spoke on "The Einstein theory of relativity." Other papers presented were:

Functions of circular curves simplified: T. F. Hickerson.

Some biological aspects of the tidal zone region of the North Carolina coast: Z. P. Metcalf.

Recent growth and depletion of sea beaches on the North Carolina coast. (Lantern): Collier Cobb.

Some remarkable forms of the skeletal element in Lithistid sponges: H. V. Wilson.

Animal locomotion: H. H. Brimley.

Single spore cultures of Coprinus radiatus: H. R. Totten.

Genera of lower Basidoimycetes new to the United States: W. C. Coker.

Turtles of North Carolina: C. S. Brimley.

Electro-endosmosis of clays: Thorndyke Saville.

The life-history of a gall-making Psyllid Pachypsylla mamma Riley. (Lantern): B. W. Wells.

Dreams and their causes, with examples: C. S. Brimley.

A little-known vetch disease: F. A. Wolf.

Notes on the mosquito fauna of North Carolina: F. Sherman.

Agricultural geology: John E. Smith.

The larger cornstalk borer Diatraea zeacolella Dyar. (Lantern): R. W. Leiby.

The wing venation of the Heteroptera: Herbert Spencer.

An interesting fertilizer problem: H. B. Arbuckle.

A list of Cicadellidæ taken at Swannanoa, North Carolina: Z. P. Metcalf and Herbert Osborn.

A phenomenal shoot (exhibit): B. W. Wells.

A peculiar Mycorhiza-forming Rhizopogon on the roots of the pine: H. R. Totten.

Effect of fertilizers on germination and seedling growth of corn and cotton. (Lantern): M. W. Sherwin.

Behind the barrier beaches from Boston to Beaufort. (Lantern): Collier Cobb.

Some investigations on the compounds isolated from the Polypores: Joseph T. Mattox and Raymond Binford.

Effect of borax on plant growth: Oscar J. Theis, Jr., and H. B. Arbuckle.

Dyestuff situation in the United States: R. F. Revson.

New ethers: A. S. Wheeler and S. C. Smith.

Further studies on the melting points of the nitrotoluenes: Jas. M. Bell.

Vitamines—a review: W. A. Withers.

Cymene, a new solvent: A. S. Wheeler.

A color reaction for pure Cymene: A. S. Wheeler.

The conductivity of nonaqueous solutions: Paul Gross.

Some new types of distillation apparatus: Paul Gross.

R. W. Leiby,
Secretary-Treasurer

Raleigh, N. C.

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.
NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, AUGUST 27, 1920

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE TEMPERATURE INTERVAL IN THE GEOGRAPHICAL DISTRIBUTION OF MARINE ALGÆ[1]

THE idea of geographical distribution came as a new and inspiring, although rather indefinite, concept to the German fathers of botany in the latter portion of the fifteenth and earlier portion of the sixteenth centuries. The attempt to explain geographical distribution according to the influence of environmental factors began, practically, with Alexander von Humboldt in 1805. Since his time, temperature has generally been regarded as the chief limiting factor in climatic distribution. In 1893, I called attention to the relationship existing between the position of the isotheres (mean maxima for the hottest month) of 10°. 15°, 20°, and 25° C. of the surface waters of the oceans and the limits of distribution of certain groups of kelps (Laminariaceæ). In 1894, and again in 1898, C. Hart Merriam proposed dividing the United States into certain "life-zones" or "crop-zones" according to the "summation-indices" of the temperature of the frostless season and showed the close relation of the boundary lines of these "zones," or belts as they may be more distinctly designated, to the isotheres (isotherms of mean maxima for the six hottest weeks of the season) of 18°, 22°, and 26° C. In 1913, Livingston and Livingston proposed a series of "efficiency indices" for use in plant distribution and climatology, presumably resting upon more of a physiological basis than the summations of temperature or statistical relations to various isotherms. The efficiency basis of their system is founded upon the application of the van't Hoff-Arrhenius principle as to the velocity of vital activities at different temperatures. In

[1] Delivered before the Princeton Biological Seminary on April 6, 1920.

1915 and in 1917, I brought forward additional facts bearing on the relation of the 0°, 10°, 15°, 20°, and 25° C. isotheres and added arguments for the careful consideration of the relation also of the 0°, 10°, 15°, 20°, and 25° C. isocrymes, or lines of mean minima, *i. e.*, the mean temperature of the coldest month, of the surface waters of the oceans, to the demarcation, or division, points in the marine floras.

The various writers I have just cited take up the subject of the relation of temperature to distribution almost entirely from the distributional side. They show certain, at least, of the relations of the intensity- and duration-variables in their influence on those activities of the organisms which make for persistence in the particular localities where they are to be found permanently. The activities controlled are, undoubtedly, all the necessarily vital activities of the organism, but we may feel fairly certain that those subject to the special control of the limited temperature interval are those more or less immediately connected with reproduction. In general, it may be said with some confidence, that the reproductive activties are carried on at the maxima of the temperatures at which the plant is actively and most normally performing any of its strictly vital functions. The initial temperatures, *e. g.*, those of the germination of the seeds or spores, are undoubtedly lower, in most cases at least, as are also those of most rapid growth and those of the most active metabolism. All, however, have their optima which are the temperatures connected with successful and orderly development, within comparatively narrow limits and are to be considered apart from the temperatures possibly to be endured in states of rigor, but without immediate death. Most of the physiological experiments on the influence of temperature on plants emphasize their sensitiveness as regards intensity, but do not yield many data bearing on duration effects of slightly unfavorable temperatures such as are most desirable for assisting in the solution of the problems of geographical distribution. A notable and illuminating discussion between the two different points of view is shown in the controversy between A. J. Ewart (1896 and 1898) and W. and G. S. West (1898). Ewart argues from the point of view of an experimental worker in the laboratory, testing under controlled conditions, while the Wests bring forward from their long experience in the field, seemingly discordant facts.

Phenologists are acquainted with many facts that tend to show the close relations existing between certain intensities of temperature and flowering in certain plants, particularly in fruit trees of temperate regions. Certain exotic ornamentals may live on from year to year in certain localities and never blossom. Some such may blossom in an occasional warm season, but not produce seeds, while the same species, in some sheltered and warmer spot in the same general region may flower every season and even produce scanty or abundant seed. Some plants may blossom only where the sun strikes them, on the southern side, in the northern hemisphere. In a hedgerow, the spotwise blossoming is often very noticeable and can readily be traced to insolation. I have watched such a hedge of Laburnum in Berkeley, California, in which the spots receiving the most sun blossomed out a week or more earlier than the rest. I have observed rows of *Azalea californica* in the neighborhood of the Yosemite Valley, largely shaded by tall trees, blossom only in the spots where the sun penetrated to them. Many such instances might be evidenced, but the resultant inference is the same. Lloyd (1917) has recorded his observations on the "Critical flowering and fruiting temperatures for *Phytolacca decandra.*" At Tucson, Arizona, this species produces flowers and seeds in abundance, but at Carmel, California, a locality of decidedly lower temperature maximum, it fails to do so, although, otherwise, it grows well and apparently normally. Plants grown in a small glass shelter at Carmel, however, produced an abundance of flowers, fruits and perfectly viable seeds. In one or two instances single branches of plants without the shelter, but in sheltered positions, also bore seeds. As a result of

temperature readings under the different conditions, Lloyd came to the conclusion that raising the temperature not over 5° F. would be sufficient to produce normal flowering at Carmel. M. Moebius (1897) has treated of the matter of temperature in his "Beiträge zur Lehre der Fortpflanzung der Gewächse" and brings forward many authenticated cases of the effects of changes of temperature on the flowering and fruiting habits of plants. He calls attention to the fact that plants provided with effective methods of vegetative multiplication, such as the members of the Lemnaceæ, may occur in abundance in cooler regions, such as Central Europe, but seldom or never (Wolffia) fruit, while they bloom and fruit abundantly in warmer regions where they are equally common. The difference in temperature in these cases is partly of greater intensity, although presumably not considerably, partly also of duration of the higher intensity.

It seems to me that it is this narrow interval of temperature which separates the carrying through of reproductive processes from their inhibition, that is indicated by correspondingly narrow temperature interval between the isotheres and isocrymes which seem to delimit so accurately the different floras from one another. From the physiological point of view, there seems to be indication that the optima of effective reproduction which makes for persistence in distribution, lie within an interval of 5° C., an interval surprisingly narrow. The controlling influence of this narrow interval, however, so far as the persistence of the various species in any zone or zones is concerned, seems well substantiated by the various tabulations and critical examination into seemingly exceptional cases which I have made and published elsewhere. The overwhelming majority of the known marine algæ of the world are recorded from only one zone. A considerable number are said to occur in two zones, a very few in three zones and a very small percentage in four or five zones. It seems, therefore, fairly certain that the normal interval is one zone of 5° C. amplitude and that the invasion of other zones than the normal is due to the existence in the invaded zones of temperatures of the same intensity and duration found in the normal zone. This has been shown in a sufficient number of cases to indicate that it is to be looked for as a general rule.

There is another interval besides that mentioned above, which has more or less to do with the life, normal and invading, of any particular zone and that is the interval of amplitude of seasonal variation in temperature in each zone. There may be certain portions of the tropical zone in which there is little, if any, seasonal change of temperature. In certain portions of the oceans, free from currents of a strongly influencing nature, the isocrymes and isotheres 5° C. apart are very nearly superposed and it seems logical to assume that this seasonal interval is normal. The extreme interval in portions of zones thus affected is, therefore, 10° C. in amplitude, the interval between extreme mean maxima and mean minima estimated from monthly variations. This interval, viz., 10° C., may be assumed to be the interval of optimum temperatures for persistence and including all actively vital processes of the particular species normal to any zone. There are regions in some zones, however, where the mean seasonal variation alone amounts to 18° or 20° C. It is undoubtedly a fact that where the seasonal interval is large and particularly where it is much greater than 5° C., the species normal to the zone pass the colder portion of the season in a state of quiescence, or rigor, either in the vegetative or in the seed or spore stages of development. In the colder seasons of any region of a zone suffering a considerable seasonal interval, the invading species from a lower zone are to be found in vegetative and reproductive activity and pass into a condition of quiescence when the temperatures characteristic of the zone prevail, a sort of heat rigor. As a result of the extreme seasonal variation in temperature of the northeastern coast of North America, for example, *Ascophyllum nodosum*, one of the rockweeds or Fucaceæ, whose normal zone is the region of Greenland in the upper boreal zone and where it develops its vegetative body

and fruits abundantly in summer and below the isothere of 10° C., extends south to the northeastern coast of New Jersey where it develops and fruits at the winter and spring temperature of 5° C., but is sterile and evidently quiescent at the summer temperature of 22° C. Since it is a perennial species, it is to be found in the southern portions of its range among the summer subtropical species of the Long Island Region and this is extremely misleading until the conditions of its existence south are understood. When these are made clear, it stands out as a conspicuous and convincing example of the narrow interval of temperature making for persistence.

Connected with these narrow intervals seeming to control persistence in certain groups of species of marine algæ and limit their distribution, there is associated the observed fact that the 10°, 15°, 20°, and 25° C. isotherms of the surface waters sharply mark off the life-zones from one another. This conclusion comes as a result of the critical study of the relations of these isotherms to certain well-known division points, or demarcation areas, between distinct floras. In a recent study of the relation of Cape Cod to the floræ of the New England coast, where I had at hand detailed information of greater abundance, variety and accuracy than it is generally possible to obtain about such matters, I found that the isothere of 20° C. certainly seemed to divide very sharply the northern species as to their distribution, from the southern. The details of this investigation will be published elsewhere, as it is unnecessary to go into them here, but I desire to mention one which will emphasize the point I am trying to make evident. At the entrance to Vineyard Sound, between Gay Head on Martha's Vineyard and Sow and Pigs off the southern end of the Elizabeth Islands, as Sumner and Davis (1913) have shown in various charts, the surface temperatures in summer are slightly above and the bottom temperatures are slightly below 20° C. and the southern species are found in the surface waters, while the northern species inhabit the depths. This, it must be remembered, is only one example of a considerable number which might be cited, to show how abruptly species stop or start in their distribution at one or another of these isotherms. The marine algæ extend slightly below 0° C. Thus far I have not been able to determine satisfactorily the conditions at the 5° C. isothere, but the 5° isocryme seems possibly a limiting line. There can be no question, as it seems to me, but that the isotherms, both isotheres and isocrymes, of 10°, 15°, 20°, and 25° C. definitely limit the extension of particular floras of marine algæ and that too, very sharply and exactly.

The explanation of the narrowness of the temperature interval seemingly, at least, of such paramount influence in controlling distribution, is by no means clear. If we lay stress on the interval of 5° C. which seems to control reproduction, we have no physiological basis at present apparent. If we consider the probability that the normal interval of each zone and its peculiar flora, is 10° C., then we may perhaps feel inclined to suggest that each marine algæ may persist up to the point where its initial vital activities, in accordance with the working of the van't Hoff-Arrhenius principle, may be doubled in velocity, but no more. In case this may be the proper explanation, the interval of 10° C. seems to be more exact and regular than it has been found to be even as determined for purely chemical reactions. Possibly the temperature intervals may have to do with the varying viscosities of the sea-water or its power to dissolve gases such as oxygen or carbon dioxide. On the other hand, it may have to do with the activities of some particular enzyme or group of enzymes which act effectively, as these are known to do, only within narrow limits of temperature. I feel, therefore, that I can do little more at the present time, than to lay emphasis on the narrowness of the interval and the seeming importance of the maximum and minimum isotherms very closely approximating 5° C. apart.

William Albert Setchell
University of California

A THIRD CAPTURE ON THE FLORIDA COAST OF THE WHALE SHARK, RHINEODON TYPUS

On June 11, 1919, a telegram was received at the American Museum of Natural History announcing the capture on the preceding day near Miami, Florida, of a 31-foot *Rhineodon* and asking if the museum wanted it for a specimen. Since it was too late to have the soft parts preserved, a message was sent making an offer for the head, gill rakers, fins, tail, and backbone, but no answer was returned.

This specimen of the whale shark was taken June 10, 1919, in the Bay of Florida near Man-of-War Key about eight miles southeast of Cape Sable. Information concerning its capture has been difficult to get (the latest account reaching me only recently), but the accounts agree that this great shark, which when first sighted looked like a piece of wreckage, was aground in about five feet of water, the center of the body on the shoal but the head and especially the tail fairly free, while the back extended about a foot above water. About a hundred bullets were fired into the shark before it finally succumbed. Holes were then cut in the skin and ropes run through these to hold the body fast when the tide rose. It was then towed to the mouth of the canal at Florida City and there skinned and the jaws taken out. Unfortunately, neither the gill-rakers nor the vertebræ were saved.

To Dr. H. Schlegel, one of the captors, I am indebted for two photographs showing the skinning, and for another in which the fish is seen lying somewhat on one side in the water alongside the wharf. This picture shows the gill slits, the dorsal ridge extending back to the first dorsal fin, the broad back from which the vertical stripes have faded, and most important of all, the lateral keel on the caudal peduncle which is such a marked feature in the description of the original discoverer, Dr. Andrew Smith.

As to size, this specimen of *Rhineodon* was said to measure 31 feet and some inches long. The body was about eight feet wide, and the mouth about five feet across. The eye is described as being as large as a base ball, but having a pupil about the size of the eye of a child. It is greatly to be regretted that there was no scientifically trained person at hand to make careful measurements and give an accurate description of this specimen. The above figures are, however, believed to be substantially correct. The weight was estimated to be about nine tons, which is probably an excessive figure.

The skin has been purchased by Mr. Arthur D. Lord, of New York, and presented to the American Museum of Natural History. It is planned to have the skin mounted, or more probably a cast made. This will be the only mounted specimen in any museum in the new world. In the old world there are specimens in the British Museum, the Paris, Madras, Colombo (Ceylon) museums, and one in the hands of a private dealer in curios in Japan. In this country there is a skin in the United States National Museum and a mounted specimen in Miami, Florida.

This is the third capture in Florida waters of *Rhineodon typus*. The first, a small specimen 18 feet in length, came ashore at Ormond, Florida, in 1902. The second specimen was taken by Captain Charles Thompson, of Miami, and Mr. Charles T. Brooks, of Cleveland, Ohio, toward the close of May, 1912. This fish measured 38 feet long and about 18 feet in circumference, and Mr. Brooks estimated its weight at five tons, while Captain Thompson thought it would weigh three time as much. Captain Thompson had this specimen mounted and placed on exhibition in Miami.

It is significant that two of the three Florida specimens have been taken in localities not more than thirty to forty miles apart, while the third, although it came ashore some distance further north, was evidently carried there by the Gulf Stream. Further it is interesting to note that one specimen was found dead, and that the other two put up fights for liberty by no means in correspondence with their immense size and strength. Mr. L. L. Mowbray, Director of the Miami Aquarium, from certain

information which has come to him from fishermen who ply their trade out in the Gulf of Mexico, thinks that near the center of the Gulf these great fish have a breeding ground, and that they are fairly abundant.

These sharks are most abundant around Ceylon, in the East Indies around Java, north among the Philippines and to the coasts of Japan. Recently a new habitat record in this region has been noted. Mr. J. Dewar Cumming, in his book "Voyage of the Nyanza . . . in the Atlantic and Pacific [Oceans]," London, 1892, says that at Hillsborough Island, the largest of the Coffin or Bailey group, in the Bonin Archipelago, he saw a whale shark, which ". . . must have measured 25 to 30 feet in length, and was at least eight feet across the shoulders. The color was of a bluish-gray, dotted with large white spots."

Rhineodon is, however, found most frequently around the Seychelles Islands in the western Indian Ocean, about midway betwixt the equator and the northern end of Madagascar. In 1914–15, an expedition was planned for the Seychelles to study *Rhineodon*, but had to be postponed on account of the great war. With the coming of peace, plans were again made, but in the face of the enormous rise in the cost of transportation, of living expenses and all commodities, another postponement has been necessary. In the meantime a correspondent at Mahé, Seychelles Islands, writes that *Rhineodon* is more plentiful there than ever.

For fuller information (in fact everything known) about this great fish, references may be made to papers by the writer previously published elsewhere.[1]

E. W. Gudger

American Museum of Natural History,
New York City

[1] "Natural History of the Whale Shark, *Rhineodon typus* Smith.," *Zoologica*, Scientific Publications New York Zoological Society, 1915, Vol. 1, pp. 349–389, 12 figs. "*Rhineodon typus*, the Whale Shark: Further Notes on its Habits and Distribution," Science, 1918, N. S., Vol. 48, pp. 622–27.

SCIENTIFIC EVENTS

THE SPAWNING GROUNDS OF THE EEL

The Bureau of Fisheries reports that Dr. Johannes Schmidt, a distinguished Danish scientist, has recently completed an exploring voyage across the Atlantic in the steamer *Dana*, of the Danish Commission for Marine Investigation. Dr. Schmidt, who is director of the Carlsberg Laboratory in Copenhagen, for about 15 years has been devoting special attention to the fresh-water eels of Europe and America, and is the leading authority on these interesting fishes, which are relatively much more important in western and southern Europe than in eastern America. Dr. Schmidt has made important contributions to the sea life of the eels, and during the recent cruise from Gibralter to Bermuda and the West Indies collected large numbers of larval eels, with a view to determining the spawning grounds of the European and American eels, which represent distinct but closely related species. Dr. Schmidt says:

> I think I am now able, after so many years' work, to chart out the spawning places of the European eel. The great center seems to be about 27° N. and 60° W. [southwest of Bermuda], a most surprising result, in my opinion. The American eel seems to have its spawning places in a zone west and south of the European, but overlapping. The larvæ of both species appear to pass their first youth together, but when they have reached a length of about 3 centimeters the one species turns to the right, the other to the left.

The assistance of the Bureau of Fisheries is invoked by Dr. Schmidt in obtaining further specimens of larval eels taken from waters off the American coast south of Cape Hatteras in sumer and autumn; most of the collections heretofore made in that region have been in winter when few eels are spawning.

AGRICULTURAL WORK AT THE UNIVERSITY OF NANKING

The latest annual report of the college of agriculture and forestry of the University of Nanking, China, as abstracted in the *Experi-*

ment Station Record, reports the progress made at this institution in the development and extension of its agricultural work. One of the events was the organization, late in 1918, of an agricultural experiment station. This action followed a recommendation by Professor C. W. Woodworth of the California University and Station, who was then temporarily serving at the college as special investigator and lecturer on entomology. Subsequently, several tracts of land, aggregating about 21 acres, were purchased at a cost of $9,000. About 5 acres have already been planted to mulberries for sericultural work, and the remainder is under general cultivation. The college also has the use of about 36 acres of vacant university land, though the small size and scattered nature of the various holdings constitute a serious handicap to experimental work. It is estimated that eventually at least 160 acres of adjacent land will be needed for the college farm and station.

Much of the principal work so far under way has dealt with sericulture. About $5,000 has been provided for this by the International Committee for the Improvement of Sericulture in China. The chief undertaking of the committee is to produce certified silk worm eggs by the Pasteur process and distribute them to farmers, studies at the college indicating an average incidence of disease of 66 per cent. for uncertified stock. This work was temporarily interrupted by fire, which destroyed the entire product for the year. The college is also grafting 100,000 mulberry trees for sale at cost in 1921 and 150,000 for 1922, and is carrying on experiments in the production of mulberry cuttings and studies in pruning, fertilization, culture, etc. Tests are being made on the utilization of the autumn crop of mulberry leaves, as well as breeding and selection work with silk worms. A three-month course in sericulture has been instituted, and extension work through lectures and demonstrations is contemplated.

Cotton experiments have already shown that certain foreign varieties can be successfully grown in China, though careful tests are necessary to determine the adaptability of varieties to diverse conditions. A cooperative test was organized in 1918 in eight provinces with pure seed of the standard test sets of the U. S. Department of Agriculture. The cotton improvement work is being supported by two Chinese cotton mill owners' associations and the Shanghai Anti-Adulteration Association.

Improvement of native corn by pedigree selection has been carried on for four years, and seed distribution to farmers is to be begun this spring. There has also been selection work with about 75 strains of lowland rice, 100 native and foreign strains of wheat, and about 100 varieties of fruits.

There is much interest in forestry, and about 7 acres of land are devoted to forest nurseries. A colonization project on Purple Mountain has largely developed into a reforestation demonstration.

The student enrollment has numbered about 100, of whom 42 were regular students in agriculture, 30 in forestry, and 26 in the short course of sericulture. The demand for trained graduates has exceeded the supply, notably for assistants for agricultural missionary work. There has been a marked increase in interest on the part of missionary organizations and also by a number of influential government officials.

ALL-AMERICAN CONFERENCE ON VENEREAL DISEASES

AN All-American Conference on Venereal Diseases will be held in Washington, D. C., December 6 to 11, 1920. It is under the auspices of four organizations—

The U. S. Interdepartmental Social Hygiene Board, represented by its executive secretary, Dr. Thos. H. Storey.

The U. S. Public Health Service, represented by Assistant Surgeon General C. C. Pierce.

The American Red Cross, represented by its president, Dr. Livingston Farrand, and

The American Social Hygiene Ass'n., represented by general director, Dr. Wm. F. Snow.

The conference will deal with both administrative and research problems, and will consider the attack on venereal diseases from four different aspects:

(1) Medical Measures,
(2) Enforcement of repression and protection laws,
(3) Sex Education and
(4) Provision of Recreational facilities.

Dr. William H. Welch, of Johns Hopkins University, is president of the conference.

An attempt will be made to work out a feasible three-year program for each of the countries of the western hemisphere. Preliminary organization is in charge of Paul Popenoe. Headquarters of the conference are at 411 Eighteenth Street, N.W., Washington, D. C.

DYE DIVISION OF THE AMERICAN CHEMICAL SOCIETY

The Dye Division of the A. C. S., which had its inception first as a Dye Symposium then as a Dye Section, is now a duly organized part of the American Chemical Society. The division is undertaking to carry on regular and systematic work for the benefit of the dye industry of America in general; and the users of dyes, manufacturers of dyes, and dye chemists in particular, laying, of course, its especial emphasis upon the chemistry of dyes and dyeing.

It is the duty and the privilege of every chemist in America, who is interested in the chemistry, manufacture, or use of dyes, to enroll himself as a member of the American Chemical Society and its Dye Division, to attend and participate in the semi-annual meetings. The advantage will be mutual, both to the members and to the industry.

To enroll yourself in the division, write to the secretary, and also inform him if you have ready for presentation any paper on the manufacture or application of dyes and intermediates. Enclose the sum of $1.00 as dues for 1920. The dues are for the expenses of the division, consisting mainly of postage and stationary. It is planned as soon as funds permit, to compile and distribute a directory of dye chemists who are registered in the Dye Division of the A. C. S.

The next meeting of the Dye Division will be at the fall meeting of the American Chemical Society, to be held in Chicago September 7 to 10, 1920. At that time it is expected that a number of dye concerns will come forward with papers of intensive scientific interest.

There has been some considerable feeling in the past that the concerns should keep all their research work secret, and that none of it could be revealed at such meetings without detriment. However, since every research laboratory turns out a large amount of work which is of very great scientific interest to the trade in general but may have no specific bearing on any process in particular, we may expect that a large number of papers will be presented of such a nature as to demand the attention of every dye laboratory.

Please plan to attend this meeting and inform the secretary of the title of any paper pertaining to the dye industry that you will have ready for presentation.

R. Norris Shreve,
Secretary

43 Fifth Avenue,
New York City

THE FEDERATED AMERICAN ENGINEERING SOCIETIES

The following invitation is being sent to engineering and allied technical organizations, asking them to become charter members of The Federated American Engineering Societies.

The joint conference committee of the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers, acting as the ad interim committee in accordance with the authorization of the organizing conference held in Washington, D. C., June 3–4, 1920, extends to your organization a cordial invitation to become a charter member of The Federated American Engineering Societies, and to appoint delegates to the first meeting of the American Engineering Council, of which due notice will be given, to be held in the fall of this year.

There has been previously sent to you an abstract of the minutes of the organizing conference, at which there were in attendance 140 delegates, representing 71 engineering and allied technical organizations. It was the unanimous opinion of

the Conference that there should be created an organization "to further the public welfare wherever technical knowledge and engineering experience are involved and to consider and act upon matters of common concern in the engineering and allied technical professions" and that this organization should consist of societies or affiliations, and not of individual members.

On the basis of these fundamentals, the attached constitution and by-laws were unanimously adopted by the conference. These contain full information concerning The Federated American Engineering Societies, the American Engineering Council, its executive board, and of the various officers and committees. The basis of representation therein stated for the American Engineering Council is one representative for from 100 to 1,000 members and an additional representative for each 1,000 members or major fraction thereof.

At the gathering in Washington, which was the greatest event in the history of the engineering and allied technical organizations in this country, steps were taken which created "The Federated American Engineering Societies," which will have a far reaching influence on the future of these professions. The fact that this action was taken without a dissenting vote indicates that the psychological moment had arrived and that there was a unanimous desire on the part of the representatives of these professions for the organization formed.

The joint conference committee, the ad interim committee would ask each organization invited to take favorable action in the matter of membership in the organization at the earliest possible moment and to advise the committee promptly of the names of the delegates who will attend the first meeting of the American Engineering Council in November of this year.

The joint conference committee is confident that with the universally acknowledged need for such an organization, there will be a prompt affirmative response to this invitation.

SCIENTIFIC NOTES AND NEWS

SIR NORMAN LOCKYER, director of Solar Physics Observatory, London, and editor of *Nature* from its establishment over fifty years ago, died on August 16 at the age of eighty-four years.

ON the occasion of the meeting of the British Association at Cardiff this week the University of Wales proposed to confer the honorary degree of D.Sc. on Dr. H. F. Osborn, president of the American Museum of Natural History, or, if he is unable to attend, Professor C. A. Kofoid, University of California; Professor G. Gilson, University of Louvain, or, if he can not attend, Dr. C. H. Ostenfeld, University of Copenhagen; Don Gullermo Joaquin de Osma, Madrid; and Professor Yves-Guyot, Paris.

DR. IRVING FISHER, professor of political economy at Yale University, has been elected president of the Eugenics Research Association.

PROFESSOR FREDERIC S. LEE, of Columbia University, and Professor Graham Lusk, of Cornell Medical College, were recently elected members of the board of the Institut Marey of Paris.

DR. G. C. SIMPSON, F.R.S., meteorologist to the government of India, has been appointed director of the British Meteorological Office as successor to Sir Napier Shaw, who retires on reaching the age-limit.

DR. HENDRIK J. VAN DER BIJL, who has for the past seven years been in charge of researches in thermionics and in vacuum tube operation at the Research Laboratory of the Western Electric Company, Inc., sailed on August 4 for Pretoria, South Africa, where he has been appointed scientific and technical adviser to the Department of Mines and Industries of the Union of South Africa.

N. H. BOWEN has resigned his professorship in Queens University, Kingston, Canada, and has rejoined the staff of the Geophysical Laboratory of the Carnegie Institution of Washington.

THE board of scientific directors of the Rockefeller Institute for Medical Research announces the appointment of Edric Brooks Smith, B.S., as business manager, and Frederick Stanley Howe, A.B., as assistant business manager.

H. W. VAUGHAN, professor of animal husbandry in the University of Minnesota, has resigned to become one of the editors of the *Duroc Digest.*

Mr. Charles W. Trigg, who has been engaged in research on coffee at the Mellon Institute for the past four years, has taken charge of the technical department of the King Coffee Products Corp., Detroit, Mich. Mr. Trigg will remain a senior fellow of the institute.

Dr. Irving Hardesty, professor of anatomy in the school of medicine, Tulane University, has been granted a leave of absence for 1920–1921, which he will spend at the University of California.

Whitman Cross, E. E. Larsen and C. P. Ross, of the U. S. Geological Survey, have spent the summer field season in the southern part of the San Juan region, Colorado.

Charles T. Kirk, of Tulsa, Oklahoma, has spent five months as economic geologist in Colombia and other Spanish-American countries.

Dr. Stephen S. Visher, assistant professor of geography, Indiana University, has been granted a semester's leave and is now in Europe. He is working on the problem of contributions to civilization, with special reference to Spain, France, Ireland and Scotland.

H. Foster Bain has been making geological examinations in Yunnan, southern China.

Professor Homer R. Dill, director of the vertebrate exhibit in the museum of the University of Iowa, is in charge of an expedition to Honolulu. Upon returning to the United States in October, Professor Dill will lead a party to the region on the border between Washington and British Columbia where collections will be made for the museum.

Mr. William L. Finley has been commissioned by the National Geographic Society to secure motion pictures of the rarer birds and mammals of North America. Mr. and Mrs. Finley have visited Arizona and the Gulf Coast of Texas, in the pursuit of this work.

Dr. Frederick Starr, associate professor of anthropology in the University of Chicago, is giving three illustrated lectures at the university on August 25, 26 and 27. The subject of his first lecture will be "The Nosatsu Kai," of the second "Ema," and of the last, "The Ascent of Mount Fiji." Professor Starr returned a few months ago from anthropological researches in Japan and Corea.

We learn from *The Condor* that the National Parks Service this year inaugurated a system of instruction in natural history for visitors to Yosemite National Park. Through cooperation with the California Fish and Game Commission, Dr. H. C. Bryant gave instruction from June 1 to August 31. Dr. L. H. Miller, department of biology, Southern Branch, University of California, was in Yosemite during part of the summer and toward the end of the season he conducted similar work at Fallen Leaf Lake, in the Tahoe region. The programs include lectures on the plant and animal life of the mountains, to be illustrated in part by lantern slides and moving pictures. Field trips will be arranged for parties of different ages.

The Civil Service Commission announces an examination for naturalist in the Bureau of Fisheries for duty on the steamer *Albatross*, at $2,200 a year. Applicants must have graduated from a college or university of recognized standing and have had at least two years' experience in biological or hydrographic investigations.

The *Bulletin* of the American Mathematical Society states that Gustav Foch, of Leipzig, offers for sale the library of the late Professor Moritz Cantor, of Heidelberg, the historian of mathematics. The library consists of about 2,000 volumes and 2,500 pamphlets.

New laboratories for research on the origin and treatment of tropical diseases were opened at Liverpool on July 24 by Lord Leverhulme. The laboratories are named after Sir Alfred Jones, the Liverpool shipowner, who took a great interest in the pioneer work done in the investigation of tropical diseases at Liverpool, and made provision in his will for the erection of a laboratory and for the buildings in which the work had hitherto been carried on.

The second International Congress of Comparative Pathology will be held at Rome in the spring of 1921 under the presidency of Professor Perroncito. Communications should be

sent to the secretary, Professor Mario Tevi Della Vida, via Palermo 58, Roma.

The Faraday Society and the Physical Society of London have arranged to hold a general discussion next October on colloidal physics and chemistry.

The thirty-ninth annual meeting of the Society of Chemical Industry was held at Newcastle-upon-Tyne on July 13–16. The gold medal of the society was presented to M. Paul Kestner, president of the Society of Chemical Industry of France. Sir William J. Pope was elected president for the ensuing year and an invitation to hold the next annual general meeting at Montreal was accepted.

The *Scientific American* is offering $5,000 for the best essay of 3,000 words explaining the Einstein theory. All essays must be in English and written as simply, lucidly and non-technically as possible. They must be typewritten and must reach the office of the *Scientific American*, 233 Broadway, New York, by November 1, 1920. The right is reserved to divide the prize between two contestants if in the opinion of the judges the best two essays are of equal merit.

The *Journal* of the American Medical Association records the appropriation by the Swedish government of 5,000 crowns to aid the Swedish Medical Association in publishing three journals, the semimonthly, quarterly and transactions. Three journals devoted to hygiene are given from 1,000 to 1,500 crowns, and four specialist journals from 500 to 1,200. To aid in starting the new *Acta Oto-Laryngologica*, 4,000 crowns are appropriated. Each of the journals specified is to donate a number of copies to the university libraries.

It is reported from Paris that the mosquito plague was so serious there last year that the Pasteur Institute has been devoting special attention to the destruction of the larvæ. An old plan was to pour oil on the waters where mosquitoes breed, but this also killed any fish there might be in the waters, besides making it unfit for drinking. M. Roubaud, of the Pasteur Institute, has now discovered a method of destroying the larvæ by sprinkling powdered formaline on the surface of the water. It is said that this does not injure fish or make water impossible to drink, and is more rapid and effective than oil.

The gift of a collection of fossils and shells which makes the University of Illinois collection of fauna and flora representing the coal period the largest extant was announced at the recent meeting of the trustees of the university. The collection was made by J. C. Carr.

UNIVERSITY AND EDUCATIONAL NEWS

The family of the late Sir John Darling, of Adelaide, South Australia, have contributed the sum of £15,000 towards the cost of erecting a new building for the medical school of the University of Adelaide. This building will be designed to accommodate the departments of physiology, biochemistry and histology and the medical library. The building will be erected and equipped at a cost of £25,000.

Mr. Walter Morrison, of Balliol College, Oxford, has just paid to Bodley's librarian the sum of £50,000 for the capital account of the library. Mr. Morrison had previously given £10,000 to each of three university funds—one for the readership in Egyptology, another for the promotion of the study of agriculture, and a third towards the establishment of a professors' pension fund.

Preliminary plans have been made for an International University, which will hold its first session in Bruxelles from September 5 to 20. The courses cover practically the whole field of higher education, but will lay special weight on questions of current interest. They will be given in the building of International Associations, and there will at the same time be held a number of congresses and meetings. The names of those who will give the courses are not announced in the preliminary program, issued in July.

Dr. R. I. Wold, for the past five years connected with the engineering department and

the research laboratories of the American Telephone & Telegraph Company and the Western Electric Company, has accepted the position of head of the physics department at Union College and will cooperate with the research laboratories of the General Electric Company in certain research work.

Professor James T. Rood, of the University of Illinois, has been appointed professor of electrical engineering at the University of Wisconsin. Professor Rood was graduated from the Worcester Polytechnic Institute in 1898 and obtained the degree of doctor of philosophy at Clark Institute in 1906. He taught nine years at Lafayette College and has since been two years on the Illinois faculty.

Fred C. Werkenthin, associate professor of botany in New Hampshire College, has been elected to an instructorship in botany in Iowa State College.

Dr. G. R. Bisby, formerly of the University of Minnesota, has accepted the position of professor of plant pathology at the Manitoba Agricultural College, Winnipeg, Canada.

Professor J. T. Wilson has been elected dean of the faculty of medicine in the University of Sydney in succession to the late Sir Thomas Anderson Stuart.

DISCUSSION AND CORRESPONDENCE

METHODS USED IN THE STUDY OF SOIL ALKALI

In Science of February 6, 1920, Mr. F. B. Headley, of Fallon, Nevada, took occasion to call attention to imperfections in methods of studying soil alkali used by the Utah Station and some other institutions. His criticism seems to center around two ideas: (1) that we consider that salts added to the soil represent the true concentration of the soil solution; (2) that we did not analyze soils to which salts had been added and that we were therefore entirely ignorant of the amount of alkali the soil contained.

Answering these in order, I may say that in Utah we have never considered salts added to the soil to be anything but *salts added*. Workers in soil science are fully aware of the fact that when such salts as carbonates are added to the soil they immediately undergo transformations that are not well understood. No one, so far as I know, would undertake to tell just what the soil solution as it affects plants really is. It is somewhat like trying to tell the composition of living protoplasm. As soon as an attempt is made to analyze the protoplasm, it is killed and its composition is probably changed. Numerous methods for arriving at the concentration of the soil solution have been suggested. These include (1) direct chemical analysis of leachings of the soil, (2) subjecting the soil to high centrifugal force in an attempt to throw off some of the real soil solution, (3) placing the moist soil under very heavy pressure to press out some of the solution, (4) attempting to obtain the osmotic pressure of the soil, (5) obtaining the conductivity of the soil to a current of electricity, (6) determining the concentration of salts by the lowering of the freezing point, and (7) getting the vapor pressure of the soil in order to determine the concentration of the soil solution.

None of these methods has been entirely satisfactory, but each one has been useful in connection with certain studies. I think it can be said therefore that at present we have no means of measuring the exact concentration of the soil solution as it affects plants. Neither the amount of salt added to the soil nor the amount recovered by chemical analyses represents the true value, and in making any interpretation it is necessary to state specifically in each case whether reference is made to "salts added" or "salts extracted." At the Utah Station we have been very careful to say which of these we referred to in every case.

In a recent publication (Utah Station Bulletin No. 170) we have taken occasion to show the relation of "salts added" to "salts recovered" by extraction using various quantities of water and stirring for different lengths of time, by the freezing point method,

and by the conductivity method. It is evident from these results that in discussing the toxic limits of alkali it will be necessary to state the method used, the same as in discussing the amount of phosphoric acid in the soil it is necessary to say whether the soil was extracted with weak citric acid, weak hydrochloric acid, or fused. The result will vary with the method of extraction.

Mr. Headley mentions several times that we have made no analyses and consequently we do not know what the soil contains. As a matter of fact, we have made thousands of analyses of soils after adding salts to them as well as soils direct from the field. In one of the papers mentioned by him[1] we have given four tables aggregating about 650 determinations to show the relation of "salts added" to "salts recovered" by extraction and as determined by depression of the freezing point.

In Utah Station Bulletin No. 170 we have given the following table:

TABLE I

Percentages of Salt Added to Soils Determined by Water Extraction

NaCl Added (p.p.m.)	No. of Samples	Mean Per Cent. Extracted	Prob. Error in Per Cent of Mean	Na_2CO_3 Added (p.p.m.)	No. of Samples	Mean Per Cent. Extracted	Prob. Error in Per Cent. of Mean	Na_2SO_4 Added (p.p.m.)	No. of of Samples	Mean Per Cent. Extracted	Prob. Error in Per Cent. of Mean
None	15	(p.p.m.) (196.3)	21	None	15 15	(p.p.m.) (727.8)	35	None	15	(p.p.m.) (454.4)	36
200	15	193.7	44	500	15	169.8	29	500	15	172.9	20
400	15	123.0	13	1000	15	95.9	25	1000	14	141.8	23
600	15	109.4	11	2000	15	58.5	19	2000	15	123.7	16
800	15	107.2	8	3000	15	57.0	15	3000	15	119.3	12
1000	15	108.2	12	4000	15	51.7	10	4000	15	115.0	14
1500	15	102.9	10	5000	15	51.1	15	5000	15	111.4	16
2000	15	102.7	8	6000	15	50.4	36	6000	15	113.3	13
2500	15	104.3	12	7000	15	48.5	17	7000	15	115.7	12
3000	15	99.8	5	8000	15	49.3	38	8000	15	119.5	16
3500	15	97.1	6	9000	15	50.3	14	9000	15	111.0	13
4000	15	95.3	8	10000	15	49.1	13	10000	15	108.1	11
Average		113.0	13			66.5	21			122.9	18

This table shows that practically all of the chlorids and sulfates added could be recovered by leaching. In the lower concentrations additional salts, which were originally present in the soil, were recovered. In the case of the sulfates very much more was recovered than was added. This came largely from calcium sulfate which was present in the soil and which was leached out by the comparatively large quantities of water used in extracting the soil. In the soil itself the calcium sulfate is not sufficiently soluble to cause injury to plants; hence, it should be subtracted from the total sulfates obtained. In the case of the sulfates the "salts added" are doubtless a more reliable index to the real concentration of the soil solution than the "salts recovered."

With the carbonates it will be seen that only a part of the salts added could be recovered by extraction. This means that in the case of carbonates a correction factor must be used for the "salts added," although this in many cases is probably just as satisfactory as to use "salts recovered."

Even though we have in all our work had available data on "salts recovered," we have in many cases preferred to indicate the concentration by "salts added," since the former method of expression is open to some rather serious objections which it is probably unnecessary to point out here.

We hope that this will clear up any misunderstanding of our work, for we believe that while "salts added" does not tell the

[1] *Journal Agricultural Research*, Vol. 15, pp. 287–319.

whole story, still it is a very convenient and useful way of indicating the alkali condition of the treatment that is under investigation.

F. S. Harris

Utah Agricultural Experiment Station,
Logan

THE RÔLE OF PSYCHOLOGICAL FACTORS IN DIGESTION

An experimental report on the relative digestibility of palatable and unpalatable food in a recent number of Science by Messrs. Holder, Smith and Hawk,[1] raises the important problem of the place of the mental factors in such activities of the human being as the partaking of food. In a general way this is the problem of the unified and complete versus the partial functioning of the organism. Now the title of the report in question, namely, "Is Unpalatable Food Properly Digested," clearly indicates that the question of the partial or incomplete functioning of the organism is in point here. For the question of palatableness is one which concerns not merely the comparatively simple, metabolic chemical reaction, but always involves a highly integrated conscious organism such as a human individual.

When we study isolated phases of an organism rather than observe the responses of the organism as a whole, we naturally arrive at different results, and so the report based upon isolated physiological data reads as follows: "If the stomach and intestine can be cajoled into making the proper effort, the unsavory concoction can be digested just about as satisfactorily as can the food mixture which makes a stronger appeal." This conclusion is reached by the observation that there is only one per cent. difference in the utilization of nitrogen when taking palatable and unpalatable food.

At this point appear some questions of extreme importance. For example, has there been sufficient time in the two days in which the unpalatable food has been adminstered for any change to take place in the functioning of the organism? Would not a protracted period of subjection to unpalatable food conditions show marked metabolic deterioration? It is decidedly an open question how long the stomach and intestine can be cajoled into making the proper effort for digestion when the organism (person) perceives and objects to the disagreeableness of the food. Indeed the writers declare that this experiment "shows how insulting we can be to the normal stomach and get away with it, but this does not necessarily prove this to be the wisest policy." Why should there be any question of policy? The answer is clear; the student of psychopathology knows full well what are the dangers of being compelled to respond to food or other situations under unfavorable circumstances. The record of broken-down organisms with incapacitating digestive symptoms is too large to leave any room for doubt as to what hygienic policy should prevail with respect to the palatableness as well as other conditions of the food-taking responses. Further, aside from the too brief period employed in the experiment, one must not lose sight of the fact that the subject was fully cognizant of responding to an experimental situation, a fact which greatly influences the stimulus-response complex.

When we consider the digestive functions as isolated activities of the organism it is beyond dispute that the absorption and utilization of the materials will depend essentially upon the chemical constitution or the food value of the materials eaten, but can we so consider human digestion? To consider digestion or any other organic process as an abstract activity is to overlook entirely the unitary character of a biological organism. Of course, no one can possibly fail to observe the value of the hypothesis that the complex activities of organisms are rather simple chemical reactions, for upon no other basis could progress be made in the investigation of such phenomena. But, this in no wise implies that in order really to understand the organism we must overlook the functioning of it as a whole. And when we do study the organism as a unit we not only find that "psychic stimuli" promote or retard the secretion of

[1] LI., p. 299.

digestive juices, but that all actions of the individual are affected by the particular surrounding conditions of such actions.

That unfortunate effects result from the failure to appreciate the fact that in dealing with the human organism we are not dealing with isolated elements is a common observation in medical practise. All too frequently an individual, who is clearly in the process of preventable disintegraton, is caused to break down completely because the elemental theory actuates the psychiatrist to pronounce that there is nothing wrong with a person having no apparent organic or functional lesion. The writer wishes to suggest, that at least from a medical standpoint, we have placed too great emphasis upon the chemical factors in the process of human digestion and too little stress upon the psychological factors.

J. R. Kantor

University of Chicago

A SIDEWALK MIRAGE

To the Editor of Science: It seems the phenomenon here described must have been noticed by many others, but it caught my attention for the first time about two weeks since, and nowhere have I seen it described.

On several occasions, lately, I have observed a mirage under the conditions hereafter stated which are those of a typical case. I was walking eastward on a cement sidewalk on a street running nearly east and west, and moving up a moderate grade which joins a nearly level stretch of walk. On reaching a point which brought my eye slightly above the level portion, and at which normally the level stretch would have been seen in its entire length, but much foreshortened, I observed instead what appeared to be a stretch of clear dark water covering the entire width of the walk, and brilliantly reflecting moving persons and other objects in sight beyond it.

The sky was clear, the air cool, the sun high. It was about three o'clock P.M., local time. There was a moderate breeze. The angle of observation was very small, probably not above three degrees. A step or two either east or west, and the water was gone, but within the proper limits, the illusion was definite and continuing. The Weather Bureau report for the day indicates that approximately 30 feet above the spot where the mirage was observed the air temperature was about 63° F. and the humidity about 63°.

The resemblance between conditions here described and those which produce the mirage on the plains is obvious.

F. W. McNair

Michigan College of Mines

SCIENTIFIC BOOKS

Helmets and Body Armor in Modern Warfare. By Bashford Dean. New Haven, Yale University Press.

To most of us armor belongs to the romantic past. We hardly think of it as a practical, up-to-date accessory of modern warfare. But in a book which has recently appeared, it is clearly demonstrated that armor has still a distinct value. We are of course familiar with the various steel helmets used by all the nations in the Great War, but it is not generally known that all the countries were hard at work experimenting with and developing body armor of every sort for their fighting men. General Pershing recognized its value and in the title page of Dr. Bashford Dean's "Helmets and Body Armor in Modern Warfare" he is quoted as saying that "effort should be continued towards a satisfactory form of body armor."

Dr. Dean is the foremost authority on armor in this country and curator of arms at the Metropolitan Museum of Art. When we entered the war he was placed in charge of the armor problem and his tireless energy and enthusiasm, together with the generous cooperation of the Metropolitan Museum, led to the development of many types of armor for our combat troops. It is unfortunate that too little of this armor was used during the final drive of 1918.

Dr. Dean views the subject from many angles. The introduction is devoted to the evolution of modern armor from early times and enables one to contrast the old with the new. The medical viewpoint is considered

with statistics showing the frequency of wounds in certain locations and its bearing on the armor problem.

The utilitarian side is shown and the advantages and disadvantages are carefully weighed. Of interest to metallurgists are tables showing the ballistic values of various metals used for armor and one interesting chapter is devoted to the subject of "yielding" armor, such as padded cotton and silk fiber. Indeed the matter is viewed both from a distance and in minute detail.

The experimental types of armor of all countries are shown and reasons given for their success or failure.

Dr. Dean's summary and conclusions are of particular interest. He believes that we have not as yet solved the problem of providing the best alloy for armor and that the end, as far as the improvement of thin plate for ballistic use, is not yet in sight.

The old struggle between bullet-proof armor and armor-piercing bullets is still on, although at the present time the armor seems to have the advantage.

The question of the best form of the American helmet is also considered. At present we are still using the British helmet and American experts agree that this model does not give sufficient protection to the back and sides of the head. Moreover, a national type should be adopted.

The question as to whether armor will be used in the future hinges not a little on the problem of getting transports to the front. The infantry-man carries a maximum necessary load without his armor which would therefore have to be sent up to him.

Considerable prejudice among the men also accounts for the unpopularity of armor—they do not wish to be burdened with it and would rather take the chances on being hit. But as the author puts it, if they can be made to see that it is really worth while, this prejudice may be overcome.

Dr. Dean, from his careful study of ancient armor and his practical knowledge of modern conditions, is qualified to speak with authority on the subject. In designing the modern helmets, a comparative study was made of the more ancient ones in the Armor Hall of the Metropolitan Museum of Art. Diagrams showing the development of armor were used and every type of helmet used with success in the past was carefully studied. If it seemed practical, a modern adaptation was designed and beaten out by hand. Due allowance was made in the design for its eventually being pressed out in millions by modern machinery. By this common-sense method Dr. Dean was able, in a comparatively short time, to weed out the impractical forms and to develop a modern type of armor made by machinery for modern warfare.

Who can say, but what it may not yet be used?

DWIGHT FRANKLIN

SPECIAL ARTICLES

DECOMPOSITION OF HYDROGEN PEROXIDE BY ORGANIC COMPOUNDS AND ITS BEARING ON THE CATALASE REACTION

THE last few years have witnessed a revival of unusual interest in the oxidizing enzymes and more particularly in catalase. The catalase reaction derives its interest from the fact that according to recent interpretations it is supposed to be a measure of the metabolic function of living matter. This view, entertained some twenty-odd years ago by Spitzer,[1] has been given much currency in late years by Burge whose numerous contributions to this topic are well known.

Considering the process of intracellular oxidation which is still very obscure it is possible to recognize three factors or enzymes involved in some way or other in the reaction. Of these the oxidases affect the oxidation of easily oxidizable substances directly; the peroxidases accomplish this indirectly by activating part of the oxygen of peroxides; lastly, the catalases by decomposing peroxides liberate inactive or molecular oxygen. It was in this sense that Loew[2] employed the designation "catalase" for the enzyme which may ultimately turn out to have no relation to the

[1] Spitzer, *Arch. ges. Physiol.*, 67, 615–656, 1897.

[2] Loew, Report 68, U. S. Department of Agriculture, 1901.

oxidation of organic substances. The occurrence of catalase is so general in plant and animal tissues that its existence certainly must have a significance. Loew conceived the idea that peroxides are formed in the cells in the process of respiration, and that the catalase saves the protoplasm from being injured by these peroxides by decomposing them as fast as they are being formed. Usher and Priestly[3] have shown that in plants at any rate hydrogen peroxide is actually one of the substances formed under the action of light and, if not immediately destroyed by catalase, will bleach the chlorophyl and thus interfere with the photosynthetic reaction. In the last few years the work of Appleman, Zaleski and Rosenberg, Loevenhart and Kastle, Alvarez and Starkweather, McArthur and notably of Burge have drawn attention to the probable function of catalase as an index of metabolic activity. Our interest in catalase originated with this fundamental problem of the relation of catalase to tissue metabolism. It may be mentioned that since our research has been in progress a number of papers appeared by Becht,[4] Stehle,[5] Reimann and Becher[6] which not merely challenge the interpretation which Burge and others place on catalases, but also their experimental findings.

The observations of which this is a preliminary report, although not bearing directly upon the fundamental problem of the catalase function, throw nevertheless interesting light on the subject. The literature contains many instances of inorganic substances, such as colloidal platinum and several others which possess remarkable catalytic power, and bring about reactions characteristic of enzymes. Thus Sjolleman[7] found that colloidal manganous oxide gives all the typical reactions for oxidases. Again Wolff[8] showed that certain iron salts can play the part of peroxidases, while Bredig's[9] "inorganic ferment"—a colloidal platinum—is capable of decomposing hydrogen peroxide as vigorously as catalase. There is, however, no record of organic substances simulating a biological process. We have discovered a group of aromatic hydrocarbons and their derivatives which give the typical catalase reaction. Such substances may undoubtedly help to throw light on the chemical structure and characteristics of the enzyme itself.

Our numerous experiments which we will report in detail later arose from the accidental observation that an enzyme preparation preserved with toluol had acquired a remarkably increased capacity for decomposing hydrogen peroxide. It was at that time also that a paper appeared by Euler and Blix[10] on yeast catalase in which these authors state that the catalase is activated by several substances, toluol among them. The idea of an activation of the enzyme by toluol seemed entirely improbable from our experience, because we found that even such minute quantities of toluol as 0.05 or 0.1 ccm. can decompose hydrogen peroxide. We undertook therefore to examine a number of related organic compounds in the hope of finding whether this non specific catalase reaction is in any way associated with the chemical structure of the organic catalysts. Starting with benzene we studied a number of its homologues and some of its derivatives. Benzene was found to react most vigorously, 0.2 ccm. liberating about 20 ccm. of oxygen from hydrogen peroxide in a manner so closely resembling the effect of an active enzyme preparation that one could not tell the difference unless informed as to the material used in the test.

The aromatic hydrocarbons of the benzene group form a series according to the number of methyl radicles attached to the ring with a gradually decreasing power to decompose hydrogen peroxide, thus:

Benzene > Toluol > Xylol > Mesitylene

[3] Usher and Priestly, *Proc. Roy. Soc. London*, 77B, 369, 1906.

[4] Becht, *Am. J. Physiol.*, 48, 171–191, 1919.

[5] Stehle, *J. Biol. Chem.*, 39, 403, 1919.

[6] Reimann and Becker, *Am. J. Physiol.*, 50, 54, 1919.

[7] Sjolleman, *Chem. Weeklad*, 6, 287–294, 1909.

[8] Wolff, *C. r. Ac. Sc.*, 146, 142–144, 781–783, 1908.

[9] Bredig, "Anorganische Fermente," 1901.

[10] Euler und Blix, *Ztschr. physiol. Chem.*, 105, 83–114, 1919.

The reaction is not general for the aromatic hydrocarbons, but is specific for those of the *benzene series*. Hydrocarbons with more than one benzene ring, like diphenyl and triphenyl methane, benzidine, naphthalene and anthracene all proved to be inert. Heterocyclic compounds also gave negative results.

We mentioned already that the increase in the number of methyl groups in the benzene ring results in a corresponding decrease of the catalytic activity of the compound. The introduction into the ring of a carboxyl group, an $NHNH_2$ group or of phenol groups renders the hydrocarbon incapable of decomposing hydrogen peroxide. On the other hand, the presence of nitro, amino and aldehyde groups, or of a halogen atom does not prevent the compound from breaking up of hydrogen peroxide, though its power is much less than that of the unsubstituted hydrocarbon. Aniline, nitrobenzene, benzaldehyde and chlorbenzene decompose hydrogen peroxide, but dichlorbenzene, benzylchloride or benzoylchloride, were found inactive. Adrenalin, both the base and the hydrochloride, decompose hydrogen peroxide though very feebly.

A more detailed discussion of the catalase-like reaction of benzene and its homologues is reserved for the near future. Suffice it to say that we have satisfied ourselves that this decomposition is not caused by changes in surface tension.

Sergius Morgulis,
Victor E. Levine
Creighton Medical College

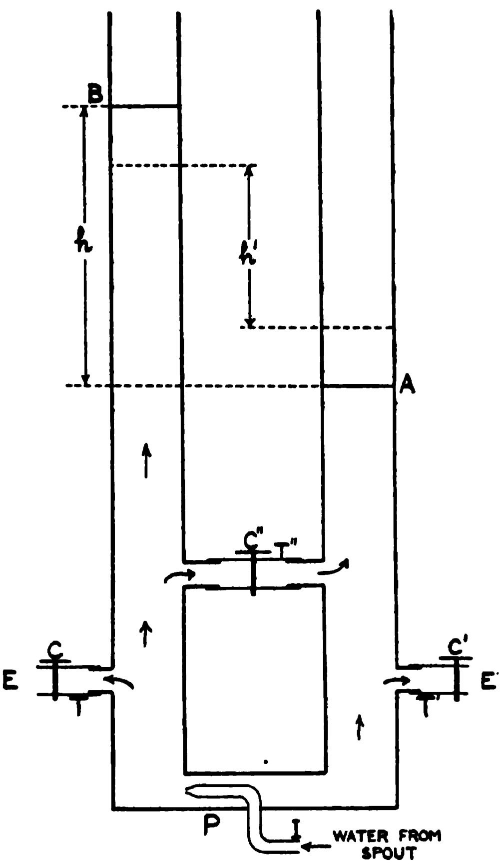


Fig. 1.

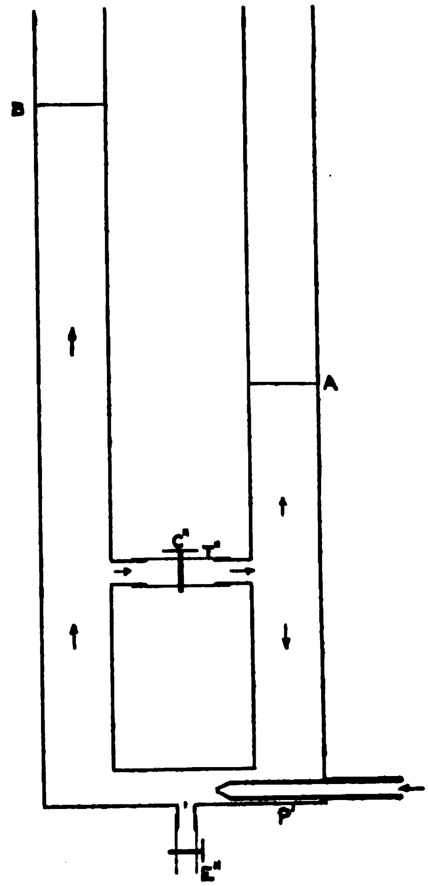


Fig. 2.

A SIMPLE DEVICE FOR SHOWING BY A HYDRAULIC ANALOGUE THE EFFECT PRODUCED ON THE POTENTIAL DIFFERENCE BETWEEN THE TERMINALS OF AN ELECTRIC CELL WHEN THE CIRCUIT IS CLOSED

THE Lodge theoretical paddle wheel device shown by Professor Kimball in Figs. 336 and 337 of his "College Physics" (ed. 1917) suggested to the writer an arrangement which would render possible an actual lecture demonstration.

Into the glass U-tube of Fig. 1 a stream of water is injected at P. The water is removed at the exits E and E', the sizes of which may be controlled by adjustable pinchcocks C and C' on the rubber tubes T and T'. The "current" is controlled by the pinchcock C'' or one's fingers on the rubber tube T''. The inflow at I may be controlled by the faucet to which the apparatus is attached. When C'' is closed, h represents the potential difference on open circuit. Upon opening C'', level B falls and A rises: $h' < h$ or the potential difference decreases when the circuit is closed.

My friend, Professor F. A. Saunders, has modified the arrangement by placing the water-spout at P' (Fig 2). This is an improvement from the pedagogic standpoint as the source of gross energy in an electric cell lies at the surface of separation between one plate and the electrolyte. He also suggests removing the injected water at but one point, E'' (Fig. 2).

NORTON A. KENT

PHYSICAL LABORATORY,
BOSTON UNIVERSITY

THE AMERICAN METEOROLOGICAL SOCIETY

THE second meeting of the American Meteorological Society was held at the Weather Bureau, Washington, D. C., on April 22, 1920. The attendance was 40 to 50 at each of the two sessions, held in the morning and in the evening. Professor C. F. Marvin, chief of the U. S. Weather Bureau gave a short address of welcome, which was followed by a program of 15 papers. Brief synopses of the papers and discussions were published in the society's bulletin for May, 1920 (pp. 48–55); and the papers themselves or authors' abstracts are still appearing in the *Monthly Weather Review* (issue shown in parentheses). The program was as follows:

**Temperature scales and thermometer scales:* E. W. WOOLARD. (May.)

Shall we adopt a half-degree absolute centigrade scale instead of the Fahrenheit? CHARLES F. MARVIN. (Not published.)

The physics of the aurora: W. J. HUMPHREYS. (Abstract to be published.)

**The auroras of March 22–25, 1920:* HERBERT LYMAN. (July (?).)

The most intense rainfall on record: B. C. KADEL. (May.)

**New aerological apparatus:* S. P. FERGUSON. (June.)

Temperatures versus pressures as determinants of winds aloft: W. R. GREGG. (Abstract, May.)

**Daily wind charts for stated levels:* C. LEROY MEISINGER. (May.)

Cloud base altitudes as shown by disappearance of balloons and kites: O. L. LEWIS. (July (?).)

**Cloud nomenclature:* CHARLES F. BROOKS. (July(?).)

**Some meteorological observations of a bombing pilot in France:* THOMAS R. REED. (April.)

Project for local forecast studies: R. H. WEIGHTMAN. (March.) (By title.)

Climatic conditions in a greenhouse as measured by plant growth: EARL S. JOHNSTON. (Abstract, April.)

Modifying factors in effective temperature: ANDREW D. HOPKINS. (April.)

Relation of rainfall to the grazing capacity of ranges: J. WARREN SMITH. (June.)

Separates have been or are to be made of those starred, and may be obtained from the U. S. Weather Bureau, Washington, D. C.

The American Meteorological Society, the project of which was announced in SCIENCE, just a year ago (August 22, 1919, pp. 180–181), and of which progress was reported (December 12, 1919, pp. 546–547) and organization in December announced (March 12, 1920, pp. 275–276), has grown with unexpected rapidity to a membership of nearly 1,000. Plans are being made for the organization of a Brazilian division of the society, and it is probable that a Pacific division will be organized when the Pacific section of the American Association for the Advancement of Science meets next summer.

The next meeting will be held in Convocation Week, December, 1920, at Chicago.

CHARLES F. BROOKS,
Secretary

WEATHER BUREAU,
WASHINGTON, D. C.

THE AMERICAN CHEMICAL SOCIETY. III

The Kaufler-Cain formula for diphenyl derivatives: OLIVER KAMM and C. S. PALMER.

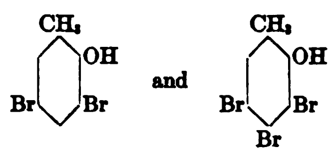
BB'-dichlorodiethyl ether: the oxygen analogue of mustard gas: OLIVER KAMM and J. H. WALDO.

The chlorination of acetone: A. W. HOMBERGER and M. BORRIES. Technical acetone was purified and treated with dry chlorine in sunlight. During the chlorination three distinct steps were noted. The first step was completed at the close of the first half hour. No hydrochloric acid was liberated during this stage. The second step lasted two hours. The heat of reaction was much higher than in the preceding step and whenever the temperature rose over 80 degrees violent reaction, resulting in flames, took place. A third step took place after this second reaction with no violent action and a temperature maintained itself below 80 degrees, and no tendency to burst into flames. During the second and third step hydrochloric acid was liberated, much more during the second than the third step. The resulting liquid of chlorination was submitted to distillation under diminished pressure and three distinct fractions obtained. The three fractions, when redistilled, showed definite and well-defined boiling points and properties. Each of these products is being investigated at present.

The use of a chart in the study of organic chemistry: CHAS. W. CUNO. The studies are divided into three great divisions, the memory studies, the reasoning studies, and the constructive studies. The two great memory studies are history and the languages. History concerns itself with data and dates, or to put it abstractly, with sequence and facts. Language concerns itself with interpretation. If we examine the reasoning studies such as chemistry we find they have a language and sequence and data that need to be made a part of the memory before the student can very well reason intelligently. In organic chemistry the language is exceedingly difficult and the data and sequence very voluminous. The use of a chart such as the one published by the author has its use, therefore, to help the student in acquiring the data, sequence and language of organic chemistry.

The mechanism of some reactions involving the Grignard reagent: HENRY GILMAN. It has been conclusively proved that the reactions of ketenes are not restricted to primary addition to the ethylenic linkage. The benzoate of triphenylvinyl-alcohol was obtained when the addition compound of diphenyl ketene and phenyl magnesium bromide was treated with benzoyl chloride. The Grignard reagent, therefore, has added to the carbonyl group. Preliminary experiments on the mode of reaction of the Grignard reagent and phenyl isocyanate (and phenyl iso-thiocyanate), indicate the following: first, but one molecule of phenyl magnesium bromide adds; second, addition takes place on the carbonyl (and thio-carbonyl) linkage; and, third, addition is probably restricted to this linkage, as with the ketenes.

The nitration of certain halogenated phenols: L. CHAS. RAIFORD. In preparing halogenated o-aminophenols with which to test further the migration of acyl from nitrogen to oxygen (*J. A. C. S.*, 41, 2068 (1919)), several of the brominated cresols were nitrated according to the method used by Zincke (*J. pr. Chem.* (2), 61, 561 (1900)), who found that in the meta series the halogen atom para to hydroxyl was replaced by the nitro group, while in the ortho and para series the atom ortho to hydroxyl was replaced. In none of these cases did he report the formation of isomeric nitro compounds in a single experiment. In the present work it has been found that the dibromo and tribromo-ortho cresols, to which Zincke has assigned the structures



both give isomers when they are nitrated as indicated above. The structures of the isomers, as well as the mother substances, are under consideration.

Action of aromatic alcohols on phenols in the presence of aluminum chloride: RALPH C. HUSTON. Earlier work has shown that aromatic alcohols (primary or secondary) are readily condensed with aromatic hydrocarbons such as benzene, toluene, etc., to form diphenyl methane or derivatives thereof. In the present work benzyl alcohol was allowed to react at relatively low temperatures with phenol in

the presence of Al Cl_3. A good yield (40–50 per cent.) of *p* benzyl phenol was obtained, according to the equation

$$C_6H_5CH_2OH + C_6H_5OH \xrightarrow{AlCl_3} C_6H_5CH_2C_6H_4OH + H_2O.$$

Slightly better yields of the ethers of this phenol were obtained by the condensation of benzyl alcohol with anisol or phenetol.

Derivatives of cyclohexane: ARNOLD E. OSTERBERG and E. C. KENDALL.

The formation of organic reactions under the electron conception of valence, reaction of formaldehyde: H. C. P. WEBER.

A new color reaction for phenols based upon the use of selenious acid: VICTOR E. LEVINE. Phenols in contact with a solution of 0.5 per cent. selenium dioxide or 0.75 per cent. sodium selenite in concentrated sulphuric acid give rise to a pale green, olive green, emerald green, blue-green or purplish blue color. Often several colors are observed simultaneously. On standing, on heating or on the addition of water the characteristic color or play of colors disappears, giving way to a dark brown, reddish brown or brick red. The reactions is of great sensitivity and of wide applicability. The following types of phenols respond to the test: Mono-, di- and triphenols, phenolic ethers, aldehydes, alcohols and acids, glycosides yielding phenols on hydrolyses, dyes and alkaloids possessing phenolic groups. Nitrating the phenol abolishes the reaction, for *o*-nitrophenol, *p*-nitrophenol, di- and trinitrophenol yield negative results. Phenolic aldehydes and acids give extremely faint reactions. The following compounds tested prove the general value of the reaction: phenol, amidol, anisole, phenetole, phenacetine, the cresols, salicylic aldehyde, salicylic acid, acetyl salicylic acid, methyl and phenyl salicylates; pyrocatechol, guaiacol, vanilin, vanillic acid, piperonal, resorcin, hydroquinone, pyrogallol, phloroglucine; eugenol, thymol, carvacrol, α- and β-naphthol, chrysarobin; the glucosides, arbutin, phloridzin; the opium alkaloids, morphin, heroin, dionin, narcotine, narceine, papaverin; the dyes, orcein, alizarin, purpurin. The reaction proves very useful in detecting phenols in solid or liquid state. Phenols dissolved in water or in an organic solvent should first be evaporated in a porcelain crucible and the test made on the dry residue. A beautiful ring test may be obtained by the addition of a chloroform or amyl alcohol solution of the phenol to the selenium reagent. A bright emerald green is observed at the point of junction of the two liquids. The green compound remains with the sulphuric acid and does not dissolve in the organic liquid. The course of the reaction may be explained on the ground that the phenol decomposes the selenous acid with the formation of free selenium. This dissolves with a green color in concentrated sulphuric acid to form selenosulphur trioxide.

A note on the differentiation of acetic anhydride from glacial acetic acid: VICTOR E. LEVINE. A differentiation based upon chemical tests may be made as follows: (1) A few drops of 0.5 per cent. selenium dioxide in concentrated sulphuric acid added to acetic anhydride results in the formation of elemental selenium, which appears as brick-red colloidal solution or precipitate. Glacial acetic acid is not affected by the selenious acid reagent. (2) Ten drops of acetic anhydride are shaken with 2 c.c. chloroform in which a few crystals of cholesterol have been dissolved. On the addition of 20 drops of concentrated sulphuric acid a fleeting purple is developed changing to blue and finally to deep green. With or without glacial acetic acid a lemon yellow color forms, which quickly goes over to deep orange, cherry red or burgundy red.

The poly-phenyl ethers: HILTON IRA JONES.

The decomposition of amines at high temperatures: FRED W. UPSON.

Oxalyl chloride in the synthesis of the triphenylmethane dyes: HARPER F. ZOLLER. Oxalyl chloride may be used in the place of phosgene or Michle's ketone in the condensing of aniline and its derivatives for the production of dye stuffs of the magenta type. The use of fused zinc chloride increases the yield of the colored base just as was found true in the case of phosgene. The calculated molecular quantities of aniline or its derivatives are mixed with a corresponding amount of oxalyl chloride necessary to produce a given dye. This mixture is heated in a flask bearing a reflux condenser and suspended in a hot water bath. Crystal violet (hexa methyl tri amino triphenylmethane) para rosaniline (tri amino triphenylmethane) have been prepared using oxalyl chloride in their synthesis. No accurate study has been made of the yields of the dyes using these synthesis. The quantity obtained using the above method amounted to about 50 per cent. of the theoretical. The synthesis is described as a very convenient laboratory method of producing the dyes in small and very pure quantities.

The benzoic acid ester of trichlorotertiary butylalcohol or chloretone benzoic acid ester: T. B.

ALDRICH. The benzoic acid ester of chloretone is prepared by heating molecular quantities of anhydrous chloretone and benzoyl chloride (slight excess) on the steam bath, until hydrochloric acid gas ceases to be given off. Any uncombined chloretone or benzoylchloride is eliminated and the resulting body recrystallized from alcohol. The ester is when pure a solid melting at 34°–35° and *not a liquid* as claimed by Willgerodt and Durr (*J. f. praktische Chemie* (Neue Folge), 39 and 40, p. 189). It may be distilled under reduced pressure without decomposition. Chlorine determinations (Carius) gave results which characterize the compound as the benzoic ester:

$$C_6H_5CO—OCC_3H_6Cl_3.$$

The compound is readily soluble in the organic solvents, and practically insoluble in water. It is not readily saponified, being much more stable than the other esters studied. Boiling with con. nitric acid does not decompose it as is the case with the aliphate esters of both chloretone and brometone. It is not volatile in the air, but is slightly volatile with steam. Pharmacological tests would indicate that it possesses less hypnotic and anesthetic properties and is less toxic than the esters studied thus far. Its relative stability is greater than that of any of the esters studied previously.

The utilization of waste silk fibroin: TREAT B. JOHNSON and P. G. DASCHAVSKY. A statistical study of the development of the waste silk industry in the United States. The behavior of fibroin on distillation is described, and an improved method of obtaining tyrosine from fibroin has been developed. It is shown experimentally that fibroin is a valuable source of the drug "tyramine," $HO \cdot C_6H_4 \cdot CH_2CH_2NH_2$.

The conversion of anilides of chloracetic acid into ketide-isothiocyanates: TREAT B. JOHNSON, ARTHUR J. HILL and ERWIN B. KELSEY. Isothiocyanates of the general formula

$$SCN \cdot CH_2 \cdot CONHR$$

have hitherto never been synthesized. A method of preparation has now been developed which eliminates any possibility of the formation of isomeric rhodanides $NCS \cdot CH_2CONHR$. The work is an extension of earlier researches on thiocyanates and isothiocyanates carried on in the Sheffield Chemical Laboratory, and has led to the development of a new method of entering the hydantoin series.

The condensation of formaldehyde with o-nitrophenol: TREAT B. JOHNSON and J. B. HISHMAN. A repetition of the work of several previous investigators has revealed the fact that *o*-nitrophenol condenses with formaldehyde to form two isomeric compounds, viz.: 3-nitro-4-hydroxy- and 3-nitro-2-hydroxybenzylalcohols. Several new derivatives of these compounds have been prepared.

The alkylation of aromatic amines by heating with alcohols: ARTHUR J. HILL and J. J. DONLEAVY. A study of the influence of catalysts on the general reactions

$$R \cdot NH_2 + R'CH_2OH \rightarrow R \cdot NH \cdot R' + N_2O$$

and

$$RNH_2 + 2R'CH_2OH \rightarrow R \cdot N(R')_2 \cdot + 2H_2O.$$

The work so far has been confined to the study of aniline and the isomeric toluidines and the two alcohols ethyl and *n*-butyl. It has been found by experiment that these alkylation reactions are greatly stimulated by using certain inorganic salts as catalytic agents. The first contribution on this subject has already been accepted for publication in the *Journal of Industrial and Engineering Chemistry*.

The search for pressor substances in the pyrimidine series: TREAT B. JOHNSON and L. A. MIKESKA. A study of some new amidine condensations leading to the formation of new types of cyclic amine combinations in the pyrimidine series. The substances under examination will be submitted to a careful pharmacological investigation to determine their pressor or other specific action. The research will be extended to the hydantoin and purine series.

The oxidation of iso-propyl alcohol by means of alkaline potassium permanganate: WM. L. EVANS and LILY BELL SEFTON.

CHARLES L. PARSONS,
Secretary

(*To be continued*)

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, SEPTEMBER 3, 1920

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

OCEANOGRAPHY AND THE SEA-FISHERIES[1]

AT the last Cardiff meeting of the British Association in 1891 you had as your president the eminent astronomer Sir William Huggins, who discoursed upon the then recent discoveries of the spectroscope in relation to the chemical nature, density, temperature, pressure and even the motions of the stars. From the sky to the sea is a long drop; but the sciences of both have this in common that they deal with fundamental principles and with vast numbers. Over three hundred years ago Spenser in the "Faerie Queene" compared "the seas abundant progeny" with "the starres on hy," and recent investigations show that a liter of sea-water may contain more than a hundred times as many living organisms as there are stars visible to the eye on a clear night.

During the past quarter of a century great advances have been made in the science of the sea, and the aspects and prospects of sea-fisheries research have undergone changes which encourage the hope that a combination of the work now carried on by hydrographers and biologists in most civilized countries on fundamental problems of the ocean may result in a more rational exploitation and administration of the fishing industries.

And yet even at your former Cardiff meeting thirty years ago there were at least three papers of oceanographic interest—one by Professor Osborne Reynolds on the action of waves and currents, another by Dr. H. R. Mill on seasonal variation in the temperature of lochs and estuaries, and the third by our honorary local secretary for the present meeting, Dr. Evans Hoyle, on a deep-sea-tow-net

[1] From the address of the president of the British Association for the Advancement of Science given at Cardiff on August 24, 1920.

capable of being opened and closed under water by the electric current.

It was a notable meeting in several respects, of which I shall merely mention two. In Section A, Sir Oliver Lodge gave the historic address in which he expounded the urgent need, in the interests of both science and the industries, of a national institution for the promotion of physical research on a large scale. Lodge's pregnant idea put forward at this Cardiff meeting, supported and still further elaborated by Sir Douglas Galton as President of the Association at Ipswich, has since borne notable fruit in the establishment and rapid development of the National Physical Laboratory. The other outstandng event of that meeting is that you then appointed a committee of eminent geologists and naturalists to consider a project for boring through a coral reef, and that led during following years to the successive expeditions to the atoll of Funafuti in the Central Pacific, the results of which, reported upon eventually by the Royal Society, were of great interest alike to geologists, biologists, and oceanographers.

Dr. Huggins, on taking the chair in 1891, remarked that it was over thirty years since the association had honored astronomy in the selection of its president. It might be said that the case of oceanography is harder, as the association has never had an oceanographer as president—and the association might well reply "Because until very recent years there has been no oceanographer to have." If astronomy is the oldest of the sciences, oceanography is probably the youngest. Depending as it does upon the methods and results of other sciences, it was not until our knowledge of physics, chemistry, and biology were relatively far advanced that it became possible to apply that knowledge to the investigation and explanation of the phenomena of the ocean. No one man has done more to apply such knowledge derived from various other subjects and to organize the results as a definite branch of science than the late Sir John Murray, who may therefore be regarded as the founder of modern oceanography.

It is, to me, a matter of regret that Sir John Murray was never president of the British Association. I am revealing no secret when I tell you that he might have been. On more than one occasion he was invited by the council to accept nomination and he declined for reasons that were good and commanded our respect. He felt that the necessary duties of this post would interfere with what he regarded as his primary life-work—oceanographical explorations already planned, and the last of which he actually carried out in the North Atlantic in 1912, when over seventy years of age, in the Norwegian steamer *Michael Sars* along with his friend Dr. Johan Hjort.

Any one considering the subject-matter of this new science must be struck by its wide range, overlapping as it does the borderlands of several other sciences and making use of their methods and facts in the solution of its problems. It is not only world-wide in its scope but extends beyond our globe and includes astronomical data in their relation to tidal and certain other oceanographical phenomena. No man in his work, or even thought, can attempt to cover the whole ground—although Sir John Murray, in his remarkably comprehensive "Summary" volumes of the *Challenger* Expedition and other writings, went far towards doing so. He, in his combination of physicist, chemist, geologist and biologist, was the nearest approach we have had to an all-round oceanographer. The International Research Council probably acted wisely at the recent Brussels conference in recommending the institution of two international sections in our subject, the one of physical and the other of biological oceanography—although the two overlap and are so interdependent that no investigator on the one side can afford to neglect the other.

On the present occasion I must restrict myself almost wholly to the latter division of the subject, and be content, after brief reference to the founders and pioneers of our science, to outline a few of those investigations and problems which have appeared to me to

be of fundamental importance, of economic value, or of general interest.

Although the name oceanography was only given to this branch of science by Sir John Murray in 1880, and although according to that veteran oceanographer Mr. J. Y. Buchanan, the last surviving member of the civilian staff of the *Challenger*, the science of oceanography was born at sea on February 15, 1873, when, at the first official dredging station of the expedition, to the westward of Teneriffe, at 1,525 fathoms, everything that came up in the dredge was new and led to fundamental discoveries as to the deposits forming on the floor of the ocean, still it may be claimed that the foundations of the science were laid by various explorers of the ocean at much earlier dates. Aristotle, who took all knowledge for his province, was an early oceanographer on the shores of Asia Minor. When Pytheas passed between the pillars of Hercules into the unknown Atlantic and penetrated to British seas in the fourth century B.C., and brought back reports of *Ultima Thule* and of a sea to the north thick and sluggish like a jelly-fish, he may have been recording an early planktonic observation. But passing over all such and many other early records of phenomena of the sea, we come to surer ground in claiming, as founders of oceanography, Count Marsili, an early investigator of the Mediterranean, and that truly scientific navigator Captain James Cook, who sailed to the South Pacific on a transit of Venus expedition in 1769 with Sir Joseph Banks as naturalist, and by subsequently circumnavigating the South Sea about latitude 60° finally disproved the existence of a great southern continent; and Sir James Clerk Ross, who, with Sir Joseph Hooker as naturalist, first dredged the Antarctic in 1840.

The use of the naturalist's dredge (introduced by O. F. Müller, the Dane, in 1799) for exploring the sea-bottom was brought into prominence almost simultaneously in several countries of northwest Europe—by Henri Milne-Edwards in France in 1830, Michael Sars in Norway in 1835, and our own Edward Forbes in 1832.

The last mentioned genial and many-sided genius was a notable figure in several sections of the British Association from about 1836 onwards, and may fairly be claimed as a pioneer of oceanography. In 1839 he and his friend the anatomist, John Goodsir, were dredging in the Shetland Seas, with results which Forbes made known to the meeting of the British Association at Birmingham that summer, with such good effect that a "Dredging Committee" of the association was formed to continue the good work. Valuable reports on the discoveries of that committee appear in our volumes at intervals during the subsequent twenty-five years.

It has happened over and over again in history that the British Association, by means of one of its research committees, has led the way in some important research or development of science and has shown the government or an industry what wants doing and how it can be done. We may fairly claim that the British Association has inspired and fostered that exploration of British seas which through marine biological investigations and deep-sea expeditions has led on to modern oceanography. Edward Forbes and the British Association Dredging Committee, Wyville Thomson, Carpenter, Gwyn Jeffreys, Norman and other naturalists of the pre-*Challenger* days—all these men in the quarter-century from 1840 onwards worked under research committees of the British Association, bringing their results before successive meetings; and some of our older volumes enshrine classic reports on dredging by Forbes, McAndrew, Norman, Brady, Alder, and other notable naturalists of that day. These local researchers paved the way for the *Challenger* and other national deep-sea expeditions. Here, as in other cases, it required private enterprise to precede and stimulate government action.

It is probable that Forbes and his fellow-workers on this "Dredging Committee" in their marine explorations did not fully realize that they were opening up a most comprehensive and important department of knowledge. But it is also true that in all his expeditions—

in the British seas from the Channel Islands to the Shetlands, in Norway, in the Mediterranean as far as the Ægean Sea—his broad outlook on the problems of nature was that of the modern oceanographer, and he was the spiritual ancestor of men like Sir Wyville Thomson of the *Challenger* Expedition and Sir John Murray, whose accidental death a few years ago, while still in the midst of active work, was a grievous loss to this new and rapidly advancing science of the sea.

Forbes in these marine investigations worked at border-line problems, dealing for example with the relations of geology to zoology, and the effect of the past history of the land and sea upon the distribution of plants and animals at the present day, and in these respects he was an early oceanographer. For the essence of that new subject is that it also investigates border-line problems and is based upon and makes use of all the older fundamental sciences—physics, chemistry and biology—and shows for example how variations in the great ocean currents may account for the movements and abundance of the migratory fishes, and how periodic changes in the physico-chemical characters of the sea, such as variations in the hydrogen-ion and hydroxyl-ion concentration, are correlated with the distribution at the different seasons of the all-important microscopic organisms that render our oceanic waters as prolific a source of food as the pastures of the land.

Another pioneer of the nineteenth century who, I sometimes think, has not yet received sufficient credit for his foresight and initiative, is Sir Wyville Thomson, whose name ought to go down through the ages as the leader of the scientific staff on the famous *Challenger* Deep-Sea Exploring Expedition. It is due chiefly to him and to his friend Dr. W. B. Carpenter that the British Government, through the influence of the Royal Society, was induced to place at the disposal of a committee of scientific experts first the small surveying steamer *Lightning* in 1868, and then the more efficient steamer *Porcupine* in the two succeeding years, for the purpose of exploring the deep water of the Atlantic from the Faroes in the north to Gibraltar and beyond in the south, in the course of which expeditions they got successful hauls from the then unprecedented depth of 2,435 fathoms, nearly three statute miles.

It will be remembered that Edward Forbes, from his observations in the Mediterranean (an abnormal sea in some respects), regarded depths of over 300 fathoms as an azoic zone. It was the work of Wyville Thomson and his colleagues Carpenter and Gwyn Jeffreys on these successive dredging expeditions to prove conclusively what was beginning to be suspected by naturalists, that there is no azoic zone in the sea, but that abundant life belonging to many groups of animals extends down to the greatest depths of from four to five thousand fathoms—nearly six statute miles from the surface.

These pioneering expeditions in the *Lightning* and *Porcupine*—the results of which are not even yet fully made known to science—were epoch-making, inasmuch as they not only opened up this new region to the systematic marine biologist, but gave glimpses of world-wide problems in connection with the physics, the chemistry and the biology of the sea which are only now being adequately investigated by the modern oceanographer. These results, which aroused intense interest amongst the leading scientific men of the time, were so rapidly surpassed and overshadowed by the still greater achievements of the *Challenger* and other national exploring expeditions that followed in the 'seventies and 'eighties of last century, that there is some danger of their real importance being lost sight of; but it ought never to be forgotten that they first demonstrated the abundance of life of a varied nature in depths formerly supposed to be azoic, and, moreover, that some of the new deep-sea animals obtained were related to extinct forms belonging to the Jurassic, Cretaceous and Tertiary periods.

It is interesting to recall that our association played its part in promoting the movement that led to the *Challenger* Expedition. Our general committee at the Edinburgh meeting of 1871 recommended that the president and council be authorized to cooperate with the

Royal Society in promoting "a Circumnavigation Expedition, specially fitted out to carry the Physical and Biological Exploration of the Deep Sea into all the Great Oceanic Areas"; and our council subsequently appointed a committee consisting of Dr. Carpenter, Professor Huxley and others to cooperate with the Royal Society in carrying out these objects.

It has been said that the *Challenger* Expedition will rank in history with the voyages of Vasco da Gama, Columbus, Magellan and Cook. Like these it added new regions of the globe to our knowledge, and the wide expanses thus opened up for the first time, the floors of the oceans, though less accessible, are vaster than the discoveries of any previous exploration.

Sir Wyville Thomson, although leader of the expedition, did not live to see the completed results, and Sir John Murray will be remembered in the history of science as the *Challenger* naturalist who brought to a successful issue the investigation of the enormous collections and the publication of the scientific results of that memorable voyage: these two Scots share the honor of having guided the destinies of what is still the greatest oceanographic exploration of all times.

In addition to taking his part in the general work of the expedition, Murray devoted special attention to three subjects of primary importance in the science of the sea, viz.: (1) the plankton or floating life of the oceans, (2) the deposits forming on the sea bottoms, and (3) the origin and mode of formation of coral reefs and islands. It was characteristic of his broad and synthetic outlook on nature that, in place of working at the speciography and anatomy of some group of organisms, however novel, interesting and attractive to the naturalist the deep-sea organisms might seem to be, he took up wide-reaching general problems with economic and geological as well as biological applications.

Each of the three main lines of investigation—deposits, plankton and coral reefs—which Murray undertook on board the *Challenger* has been most fruitful of results both in his own hands and those of others. His plankton work has led on to those modern planktonic researches which are closely bound up with the scientific investigation of our sea-fisheries.

His work on the deposits accumulating on the floor of the ocean resulted, after years of study in the laboratory as well as in the field, in collaboration with the Abbé Renard of the Brussels Museum, afterwards professor at Ghent, in the production of the monumental "Deep-Sea Deposits" volume, one of the *Challenger* Reports, which first revealed to the scientific world the detailed nature and distribution of the varied submarine deposits of the globe and their relation to the rocks forming the crust of the earth.

These studies led, moreover, to one of the romances of science which deeply influenced Murray's future life and work. In accumulating material from all parts of the world and all deep-sea exploring expeditions for comparison with the *Challenger* series, some ten years later, Murray found that a sample of rock from Christmas Island in the Indian Ocean, which had been sent to him by Commander (now Admiral) Aldrich, of H.M.S. *Egeria*, was composed of a valuable phosphatic material. This discovery in Murray's hands gave rise to a profitable commercial undertaking, and he was able to show that some years ago the British Treasury had already received in royalties and taxes from the island considerably more than the total cost of the *Challenger* Expedition.

That first British circumnavigating expedition on the *Challenger* was followed by other national expeditions (the American *Tuscarora* and *Albatross*, the French *Travailleur*, the German *Gauss*, *National* and *Valdivia*, the Italian *Vettor Pisani*, the Dutch *Siboga*, the Danish *Thor* and others) and by almost equally celebrated and important work by unofficial oceanographers such as Alexander Agassiz, Sir John Murray with Dr. Hjort in the *Michael Sars*, and the Prince of Monaco in his magnificent ocean-going yacht, and by much other good work by many investigators in smaller and humbler vessels. One of these supplementary expeditions I must refer to briefly because of its connection with sea-fisheries. The

Triton, under Tizard and Murray, in 1882, while exploring the cold and warm areas of the Faroe Channel separated by the Wyville-Thomson ridge, incidentally discovered the famous Dubh-Artach fishing grounds, which have been worked by British trawlers ever since.

Notwithstanding all this activity during the last forty years since oceanography became a science, much has still to be investigated in all seas in all branches of the subject. On pursuing any line of investigation one very soon comes up against a wall of the unknown or a maze of controversy. Peculiar difficulties surround the subject. The matters investigated are often remote and almost inaccessible. Unknown factors may enter into every problem. The samples required may be at the other end of a rope or a wire eight or ten miles long, and the oceanographer may have to grope for them literally in the dark and under other difficult conditions which make it uncertain whether his samples when obtained are adequate and representative, and whether they have undergone any change since leaving their natural environment. It is not surprising then that in the progress of knowledge mistakes have been made and corrected, that views have been held on what seemed good scientific grounds which later on were proved to be erroneous. For example, Edward Forbes, in his division of life in the sea into zones, on what seemed to be sufficiently good observations in the Ægean, but which we now know to be exceptional, placed the limit of life at 300 fathoms, while Wyville Thompson and his fellow-workers on the *Porcupine* and *Challenger* showed that there is no azoic zone even in the great abysses.

Or, again, take the celebrated myth of "Bathybius." In the 'sixties of last century samples of Atlantic mud, taken when surveying the bottom for the first telegraph cables and preserved in alcohol, were found when examined by Huxley, Haeckel and others to contain what seemed to be an exceedingly primitive protoplasmic organism, which was supposed on good evidence to be widely extended over the floor of the ocean. The discovery of this Bathybius was said to solve the problem of how deep-sea animals were nourished in the absence of seaweeds. Here was a widespread protoplasmic meadow up which other organisms could graze. Belief in Bathybius seemed to be confirmed and established by Wyville Thomson's results in the *Porcupine* Expedition of 1869, but was exploded by the naturalists in the *Challenger* some five years later. Buchanan in his recently published "Accounts Rendered" tells us how he and his colleague Murray were keenly on the look-out for hours at a time on all possible occasions for traces of this organism, and how they finally proved, in the spring of 1875 on the voyage between Hong-Kong and Yokohama, that the all pervading substance like coagulated mucus was an amorphous precipitate of sulphate of lime thrown down from the seawater in the mud on the addition of a certain proportion of alcohol. He wrote to this effect from Japan to Professor Crum Brown, and it is in evidence that after receiving this letter Crum Brown interested his friends in Edinburgh by showing them how to make Bathybius in the chemical laboratory. Huxley at the Sheffield meeting of the British Association in 1879 handsomely admitted that he had been mistaken, and it is said that he characterized Bathybius as "not having fulfilled the promise of its youth." Will any of our present oceanographic beliefs share the fate of Bathybius in the future? Some may, but even if they do they may well have been useful steps in the progress of science. Although like Bathybius they may not have fulfilled the promise of their youth, yet, we may add, they will not have lived in the minds of man in vain.

Many of the phenomena we encounter in oceanographic investigations are so complex, are or may be affected by so many diverse factors, that it is difficult, if indeed possible, to be sure that we are unravelling them aright and that we see the real causes of what we observe.

Some few things we know approximately—nothing completely. We know that the greatest depths of the ocean, about six miles, are a little greater than the highest mountains on land, and Sir John Murray has calculated that

if all the land were washed down into the sea the whole globe would be covered by an ocean averaging about two miles in depth. We know the distribution of temperatures and salinities over a great part of the surface and a good deal of the botton of the oceans, and some of the more important oceanic currents have been charted and their periodic variations, such as those of the Gulf Stream, are being studied. We know a good deal about the organisms floating or swimming in the surface waters (the epi-plankton), and also those brought up by our dredges and trawls from the bottom in many parts of the world—although every expedition still makes large additions to knowledge. The region that is least known to us, both in its physical conditions and also its inhabitants, is the vast zone of intermediate waters lying between the upper few hundred fathoms and the bottom. That is the region that Alexander Agassiz from his observations with closing tow-nets on the *Blake* Expedition supposed to be destitute of life, or at least, as modified by his later observations on the *Albatross*, to be relatively destitute compared with the surface and the bottom, in opposition to the contention of Murray and other oceanographers that an abundant meso-plankton was present, and that certain groups of animals, such as the Challengerida and some kinds of Medusæ, were characteristic of these deeper zones. I believe that, as sometimes happens in scientific controversies, both sides were right up to a point, and both could support their views upon observations from particular regions of the ocean under certain circumstances.

But much still remains unknown or only imperfectly known even in matters that have long been studied and where practical applications of great value are obtained—such as the investigation and prediction of tidal phenomena. We are now told that theories require re-investigation and that published tables are not sufficiently accurate. To take another practical application of oceanographic work, the ultimate causes of variations in the abundance, in the sizes, in the movements and in the qualities of the fishes of our coastal industries are still to seek, and not withstanding volumes of investigation and a still greater volume of discussion, no man who knows anything of the matter is satisfied with our present knowledge of even the best-known and economically most important of our fishes such as the herring, the cod, the plaice and the salmon.

Take the case of our common fresh-water eel as an example of how little we know and at the same time of how much has been discovered. All the eels of our streams and lakes of N.-W. Europe live and feed and grow under our eyes without reproducing their kind—no spawning eel has ever been seen. After living for years in immaturity, at last near the end of their lives the large male and female yellow eels undergo a change in appearance and in nature. They acquire a silvery color and their eyes enlarge, and in this bridal attire they commence the long journey which ends in maturity, reproduction and death. From all the fresh waters they migrate in the autumn to the coast, from the inshore seas to the open ocean and still westward and south to the mid-Atlantic and we know not how much further—for the exact locality and manner of spawning has still to be discovered. The youngest known stages of the Leptocephalus, the larval stage of eels, have been found by the Dane, Dr. Johannes Schmidt, to the west of the Azores where the water is over 2,000 fathoms in depth. These were about one third of an inch in length and were probably not long hatched. I can not now refer to all the able investigators—Grassi, Hjort and others—who have discovered and traced the stages of growth of the Leptocephalus and its metamorphosis into the "elvers" or young eels which are carried by the North Atlantic drift back to the coasts of Europe and ascend our rivers in spring in countless myriads but no man has been more indefatigable and successful in the quest than Dr. Schmidt, who in the various expeditions of the Danish Investigation Steamer *Thor* from 1904 onwards found successively younger and younger stages, and who is during the present summer engaged in a traverse of the Atlantic to the West Indies in the hope of

finding the missing link in the chain, the actual spawning fresh-water eel in the intermediate waters somewhere above the abysses of the open ocean.

Again, take the case of an interesting oceanographic observation which, if established, may be found to explain the variations in time and amount of important fisheries. Otto Pettersson in 1910 discovered by his observations in the Gullmar Fjord the presence of periodic submarine waves of deeper salter water in the Kattegat and the fjords of the west coast of Sweden, which draw in with them from the Jutland banks vast shoals of the herrings which congregate there in autumn. The deeper layer consists of "bankwater" of salinity 32 to 34 per thousand, and as this rolls in along the bottom as a series of huge undulations it forces out the overlying fresher water, and so the herrings living in the bankwater outside are sucked into the Kattegat and neighboring fjords and give rise to important local fisheries. Pettersson connects the crests of the submarine waves with the phases of the moon. Two great waves of salter water which reached up to the surface took place in November, 1910, one near the time of full moon and the other about new moon, and the latter was at the time when the shoals of herring appeared inshore and provided a profitable fishery. The coincidence of the oceanic phenomena with the lunar phases is not, however, very exact, and doubts have been expressed as to the connection; but if established, and even if found to be due not to the moon but to prevalent winds or the influence of ocean currents, this would be a case of the migration of fishes depending upon mechanical causes, while in other cases it is known that migrations are due to spawning needs or for the purpose of feeding, as in the case of the cod and the herring in the west and north of Norway and in the Barents Sea.

William A. Herdman

University of Liverpool

JOHN SAHLBERG

John Reinhold Sahlberg passed away on the eighth of May, 1920, in Helsingfors, Finland, seventy-five years of age, having been born in Helsingfors, June, 1845.

Descriptive entomology has lost one of its prominent men; entomological societies—especially the famous Societas pro Fauna and Flora Fennica—an enthusiastic member and officer; the University of Helsingfors a learned teacher, who knew how to guide his pupils to the very source of biological knowledge—nature herself.

John Sahlberg was an unwearied and highly experienced collector, famous all over Europe, who up to his old age, undertook extensive and strenuous excursions throughout all parts of his native country. He also collected in many other countries of the old world, traveling through the northern parts of Scandinavia and Siberia, and staying in the Caucasus, Turkestan, Greece and Italy. Three times during the years 1895 and 1904 he visited Asia Minor, Palestine and Egypt. Although thoroughly familiar with all branches of entomology, it was the Cicadariæ and the Coleoptera which attracted his especial attention, and to these groups he devoted much study.

Among the many publications of John Sahlberg the following may be mentioned:

1871: Öfversigt of Finlands och den Skandinaviska halföns Cicadariæ.

1873–89: Enumeratio Coleopterorum Fenniæ.

1878–80: Bidrag till Nordvestra Sibiriens Insekt Fauna.

1900: Catalogus Coleopterorum Fenniæ Geographicus.

1912–13: Coleoptera Mediterranea Orientalia.

He has left his entomological collections, which are large and of rare systematic and faunistic value, to the Zoological Museum of Helsingfors.

John Sahlberg belonged to an old Finnish family which for generations has been connected with the learned institutions of their native land. His grandfather (Carl Reinhold S.) was professor in natural history, first at the Åbo Academy of Science, later at the University of Helsingfors. After extensive travels over all parts of the world, his father (Reinhold Ferdinand S.) was for a period teacher in zoology at the University of Helsingfors.

John Sahlberg himself was only twenty-six years old when he was appointed teacher in zoology at the University of Helsingfors. At the same institution he was professor extraordinarius in entomology from 1883 to 1918.

John Sahlberg's son is Dr. Uunio Saalas, Helsingfors (now Helsinki), an entomologist of very high standing and of international reputation.

John Sahlberg was a man of firm character and deeply interested in Christian movements and associations, especially the Y. M. C. A. and a Christian association of Finnish University students. He also was a very enthusiastic spokesman for prohibition, especially advocating it among young men. He has published and lectured on prohibition and Christian subjects.

A. G. Böving

SCIENTIFIC EVENTS

THE PUBLICATION OF SCIENTIFIC BOOKS IN FRANCE

The Paris correspondent of the *Journal* of the American Medical Association writes:

The paper shortage and publishing difficulties still arouse a lively interest. M. Ducrot, in an informative article in the *Revue Scientifique* on the subject of scientific publishing in France, showed that if there was a crisis in the publication of literary works, this was particularly acute in the case of works on pure science. In fact, the elements of bookmaking have increased considerably in cost as compared to prices before the war: compositors and pressmen are paid from three to four times as much as in 1914, the price of paper is five times as great, and these factors contribute to make the cost of a book from three to four times as much as before the war. Now, the income of the intellectual classes, the only purchasers of theoretic works, has barely doubled, while the budgets of public institutions, libraries, laboratories, etc., have been greatly reduced. A book, even one that constitutes a veritable working tool, is not a prime necessity. It should not, therefore, exceed a certain price, above which it will not sell, and at the present moment, the maximum has apparently been reached.

This condition, which constitutes a veritable danger to the advance of science, is not peculiar to France. A statistical study by M. Fernand Roches in the *Correspondant* discloses the progressive decrease of the number of publications in the principal countries since 1914. Exclusive of periodicals and musical works, the figures show that a number of books published in 1918, as compared to 1917, decreased in France from 5,054 to 4,484; in Great Britain from 8,131 to 7,716; in Italy from 8,349 to 5,902; in the United States from 10,060 to 9,237, and in Germany from 14,910 to 14,743. The production in 1919 is not yet known, but it was probably less than in 1918.

It is interesting to note that the decrease in Italy totaled 2,447 books; in the United States 823; in France 570, and in England 415; but Germany, defeated and disorganized, showed a decrease of only 167 works.

So far as French medical books are concerned, statistics recently published in the *Bibliographie de la France* indicate that the number of such works, which had suffered a great decrease before the war (from 1,230 in 1910 to 721 in 1914), had again greatly declined in 1915, namely, to 202 works. A tendency to improvement was noted in 1916, and again in 1917, when 292 books appeared. However, in 1918, a new decline set in which it was believed would be accentuated in 1919, but nothing of the sort occurred and in that year 309 new books appeared.

CHEMICAL RESEARCH IN LONDON

A COMMITTEE presided over by Professor J. F. Thorpe, of the Imperial College of Science and Technology, London, has made a report recommending the creation of an All-India Chemical Service, the establishment of a central research institute at Dehra Dun, and of a similar laboratory in each province near the chief seat of industry. The broad object is to assist by scientific investigation in overcoming the difficulties and deficiencies in Indian industrial organization pointed out by the Holland Commission.

The summary in the *London Times* states that while it is the intention of Professor Thorpe and his colleagues that the research institutes should be staffed mainly by Indians, it is manifest that the universities and institutes of the country do not provide adequate training for the research work which will fall to the service. The qualifications laid down are an honor degree in the first and second class or its equivalent; a suitable training in

engineering (workshop practise and machine drawing); and one or two years training in the methods of research under a professor or teacher of a university or university institution who is competent to train in research. Sir P. C. Ray, who stands only second to Sir Jagadis Bose in eminence as an Indian scientist, in a dissentient note disapproves of the creation of yet another Indian service, and thinks the best results could be achieved by improving the teaching of chemistry in the universities. They should be encouraged to strengthen the staff of chemical teachers and to offer research scholarships. Technological institutes should be attached to each university as an adjunct to the chemical and physical departments.

The attractiveness *prima facie* to men of high scientific attainment of dependence on the universities has been shown in the last few months in the correspondence columns of *Nature*. In his introductory note to the report Dr. Thorpe, who may be presumed to have had strong leanings in the same direction when his inquiries began, is unhesitating in his conclusion that the development of chemical industries in India can only be adequately realized through the agency of an efficient Government Chemical Service. At the outset the report refers to the method, found satisfactory in England, of government subventions to research associations in the various branches of industry. But in India, with its comparatively undeveloped great natural resources, "a more intimate system of state assistance" is held to be necessary. Similarly, it is not possible at present to rely upon the Indian universities to complete the training necessary for appointment to the service, and selected students must be sent abroad under a system of maintenance agents.

It is pointed out that the formation of the service will necessitate a strengthening of the chemical departments of Indian universities and institutions. The professors of chemistry should be relieved of some of their routine work, and could then devote an appreciable amount of time to training their senior students in methods of research. The formation of a service for the purpose of industrial research does not mean that university professors should be discouraged from doing similar work. Dr. Thorpe, in his introductory note, says that while it is impossible and unnecessary to have laboratories attached to the universities fitted with full-scale apparatus, there should be attached to the chemical department in every university a laboratory of comparatively small dimensions, containing types of every kind of plant used in chemical manufacture of about one sixtieth the size of the large scale plant.

The proposed Chemical Service touches the educational service or educational institutions directly only in so far as concerns the efficient training of its recruits in research methods. For this reason it is not proposed that professors and teachers of chemistry should normally be members of the service. It would be open to the Education Department or to an educational institution to ask for a chemist to be seconded from the service if it so desires. Such chemists would retain their lien on their appointment in the Chemical Service, and could revert thereto on promotion, on their own request, or on the request of the authorities to whom their services had been lent.

NORTH AMERICAN FOREST RESEARCH

THE National Research Council reports that it has published a complete summary of all of the scientific investigations upon forest problems which are now under way in the United States and in Canada as a bulletin upon "North American Forest Research." This bulletin was compiled by a committee of the Society of American Foresters composed of:

Earl H. Clapp, assistant forester, U. S. Forest Service.

Clyde Leavitt, commissioner of conservation of Canada, Ottawa.

Walter Mulford, professor of forestry, University of California.

J. W. Toumey, director of the forest school, Yale University.

E. A. Ziegler, director, State Forest Academy, Mount Alto, Penn.

In this bulletin 519 different projects for investigation are described, including the re-

forestation of cut-over areas, the replacement of timber cuttings by natural growth, the control of insect pests and fungus diseases of forest trees, beneficial modifications of lumbering practise, the preservation of timber in use, the utilization of by-products, and the relation of forestry to rainfall, control of flood waters, grazing, etc.

The importance of the most penetrating study upon the conservation of our remaining forest resources is brought home by the recent announcement of the Forest Service that "three fifths of the original timber of the United States is gone and that we are using timber four times as fast as we are growing it." Our annual consumption of lumber alone is over 300 board feet per capita, and of newsprint is 33 pounds per capita. Cut and burned over forest lands in the United States, now waste territory, equal in area the whole of the present standing forests of Denmark, Germany, Holland, Belgium, France, Switzerland, Spain and Portugal. The total population of these countries is about 152,200,000, nearly 50 per cent. greater than the population of the United States.

OFFICE OF DEVELOPMENT WORK

COMMERCIAL and industrial concerns will be helped to apply new processes and discoveries of chemists in the United States Department of Agriculture by an Office of Development Work just created by the Secretary of Agriculture in the Bureau of Chemistry. The staff of the new service will be made up of engineers rather than chemists. David J. Price, chief engineer in the dust-explosion investigations conducted by the department, will be in charge of the new work.

Dr. Carl L. Alsberg, chief of the Bureau of Chemistry, in a letter to the secretary stated that such a service is urgently needed to translate the work of the bureau into terms that could be understood and applied by the manufacturer and investor. Every year valuable discoveries are made concerning the utilization of manufacturing waste, or a new food is found, or a new dye, glue, or preservative. Without the service of a business office such as is now provided the value of these discoveries is greatly reduced through the discoverers's inability to present his proposition in terms which the business man can understand, and the public runs the risk of losing a much-needed material. Under the new organization the engineers will look after the product as soon as it has passed beyond an experimental or laboratory stage and will prepare estimates for the convenience of the manufacturers.

Mr. Price and his associates will furnish data upon raw-material supply, cost of production, and the uses to which the product is adapted—in short, they provide an unbiased practical prospectus to show the public exactly what may be expected from the new material or process on a quantity-production scale. It is believed this cooperation will develop many neglected sources of public and private profit.

SCIENTIFIC NOTES AND NEWS

PROFESSOR GEORGE M. STEWART, director of the H. K. Cushing Laboratory of Experimental Medicine of Western Reserve University, had conferred on him the degree of doctor of laws at the recent commencement exercises of the University of Edinburgh.

THE honorary fellowship of the Royal College of Surgeons of England has been conferred on Professor A. Depage, of Brussels; M. Pierre Duval, of Paris; Prof. John M. T. Finney, of The Johns Hopkins University, Baltimore, and Dr. Charles H. Mayo, of Rochester, Minnesota.

THE University of Ottawa has conferred the degree of doctor of literature on Dr. J. C. McWalter, high sheriff of Dublin, and president of the Dublin Branch of the British Medical Association.

BARON GERARD DE GEER, of Stockholm, has arrived in this country to study the geological chronology since the ice age in the United States and Canada. He is accompanied by his wife and Drs. Ernest Antevs, and Ragnar Lidén.

DR. N. L. BRITTON, director of the New York Botanical Garden, accompanied by Mrs. Brit-

ton will visit the botanical institutions of Great Britain, France and Switzerland, particularly in reference to investigations of the flora of northern South America.

Dr. Franklin L. Hunt, physicist in the aeronautic instruments section of the Bureau of Standards, who has been detailed to Paris, France, for a period of twelve months, to serve as the bureau's representative in relations with the scientific and aviation authorities of England, France, Italy, Belgium and Holland, is expected to return about the first of October.

Dr. David Marine, associate professor of experimental medicine in Western Reserve University, Cleveland, has been elected director of laboratories in the Montefiore Home and Hospital, New York City.

Mr. R. G. Upton, formerly with the Texas State Board of Health as assistant sanitary engineer, now has charge of inspection and laboratory work for the city of Port Arthur, Texas, where he is chemist and sanitary engineer.

Dr. Nicholas Kopeloff has accepted the position of associate in bacteriology at the Psychiatric Institute of the N. Y. State Hospitals, after resigning the position of bacteriologist of the Louisiana Sugar Experiment Station.

Claude Wakeland, deputy state entomologist of Colorado and in charge of alfalfa weevil investigations from 1917 to 1919, has accepted the position of state extension entomologist with headquarters at Boise.

The Robert Koch endowment at Berlin has granted Professor Flügge of Berlin 15,000 marks and Professor Selter of Königsberg 6,000 marks to aid in continuing their research on tuberculosis.

Dr. R. S. Morrell has been elected president of the British Oil and Color Chemists' Association in succession to Dr. F. Mollwo Perkin.

Major W. E. Simnett has retired from the direction and editorship of the *Technical Review* on his appointment to direct the Intelligence Branch of the British Ministry of Transport.

Dr. J. G. Lipman, director of the New Jersey Experiment Station, has been appointed consulting editor of *Annales de la Science Agronomique Française et Etrangère.*

Harvey Bassler and J. B. Mertie, Jr., on furlough from the U. S. Geological Survey, are engaged in oil geology with Eugene Stebinger in Bolivia.

Professor C. O. Sauer, of the University of Michigan, is in charge during the month of September of a summer geological camp at Mills Springs, Wayne County, Ky.

Dr. Stephen Taber, professor of geology at the University of South Carolina, has been giving courses in geology and seismology at Stanford University during the summer quarters.

The Royal College of Physicians of London has appointed lecturers as follows: Dr. F. Parkes Weber, Mitchell lecturer, 1921; Dr. G. Graham, Goulstonian lecturer, 1921; Dr. T. Lewis, Oliver Sharpey lecturer, 1921; Dr. A. Whitfield, Lumleian lecturer, 1921; Dr. R. O. Moon, FitzPatrick lecturer, 1921; and Dr. G. M. Holmes, Croonian lecturer, 1922.

In memory of Dr. John B. Murphy, of Chicago, who died in 1916, it is proposed that there be constructed at an estimated cost of five hundred thousand dollars, the John B. Murphy Memorial Hall of the American College of Surgeons on a site in Chicago given by a number of prominent citizens and accepted by the regents in behalf of the college. In this memorial the college will acquire a building architecturally beautiful and much needed for important conferences and convocations and meetings for national and local medical societies. Space will be provided also in which it is proposed to maintain a pantheon of American medicine and surgery.

John Perry, professor of mathematics at the Finsbury Technical College and later at the Royal College of Science, London, died on August 4 at the age of seventy years.

The death is announced at the age of eighty-three years of Dr. Armand Gautier, formerly professor of chemistry at the University of

Paris, president of the Academy of Sciences and of Medicine.

DR. O. SCHULTZE, professor of anatomy and physiology in the University of Wurzburg, has died at the age of sixty-one years.

WILLIAM HODGSON ELLIS, former professor of applied chemistry and dean of the faculty of applied science at the University of Toronto, died on August 24, in his seventy-fifth year.

WILLIAM JAMES WILSON, for many years paleobotanist for the Canadian Geological Survey, died at Ottawa, on August 21, aged sixty-nine years.

PROFESSOR H. D. FRARY, assistant professor of steam and gas engineering at the University of Wisconsin with his wife was drowned in August in the Wisconsin river at Kilbourn, while on a camping trip. Professor Frary had been on the university faculty during the past academic year and during the previous two years had been connected with the Forest Products laboratory. He was a graduate of the University of Minnesota and obtained the degree of doctor of philosophy at the University of Illinois in 1918.

THE sixth national exposition of chemical industries will be held in the Grand Central Palace during the week of September 20.

THE British government has provided a sum not exceeding £100,000 as a guarantee against loss resulting from the holding of a British Empire Exhibition in London next year. The grant is conditional on the provision of a further sum of £500,000 by the promoters of the enterprise.

THE Second International Congress of Comparative Pathology will be held in Rome in the spring of 1921 under the presidency of Professor Perroncito.

THE International Surgical Society at its recent general assembly, decided to hold its next international congress at London, July, 1923, under presidency of Professor Macewen of Glasgow.

IT is stated in *The Observatory* that the late Mr. T. W. Backhouse has left his astronomical journals and drawings of Jupiter and Mars to the British Astronomical Association. His trustees are to complete and publish his star maps for tracing meteor paths, and they have £700 left to them to cover the completion and publication of scientific calculations based on observations made by him in astronomy, meteorology, and other branches of science.

THE Academy of Medicine of Buenos Aires has decided to celebrate its first centenary in 1922 with a contest on medicine and allied sciences. Three prizes will be granted for the best papers presented; the first of 5,000 pesos and a gold medal, the second 3,000 pesos and a silver medal and the third 1,000 pesos and a diploma.

A SUM of 500,000 marks has been donated to the University of Heidelberg to found an institute for research on albumins. It is to be in charge of Professor Kossel, and to be affiliated with the Institute for Hygiene.

PROFESSOR J. IJIMA, of the University of Tokyo, has presented fifty Japanese birds to the University of California Museum of Vertebrate Zoology, and Dr. William S. Kew, of the United States Geological Survey, has presented to the department of paleontology a collection of shells.

A REORGANIZATION of the division of entomology at the University of California is announced. The personnel of the division consists of eight members and will hereafter be known as the division of entomology and parasitology with Professor W. B. Herms as newly appointed head. Professor Herms will continue his activities in the field of parasitology, particularly medical entomology and ecology, while Professor C. W. Woodworth will devote his time largely, if not wholly, to research. The new organization of the division embraces three groups with Assistant Professor E. C. Van Dyke as chairman in supervision of activities in general entomology and taxonomy; Assistant Professor Essig, chairman in supervision of agricultural entomology, and Assistant Professor S. B Freeborn supervising activities in parasitology, particularly in relation to the animal industries. Dr. H. H. Sev-

erin will continue investigating *Eutetix tenella* in relation to sugar beet blight, while Messrs. E. R. de Ong and G. A. Coleman will continue their activities in their respective fields, namely, university farm school and agriculture, respectively.

The Olympia Agricultural Company, Ltd., is a British syndicate which has purchased agricultural estates aggregating 20,000 acres in the counties of Yorkshire, Northamptonshire, Cambridgeshire, Suffolk, Warwickshire and Wiltshire. The *Experiment Station Record* states that a research department has recently been organized under the direction of Dr. Charles Crowther, professor of agricultural chemistry in the University of Leeds and director of the institute for research in animal nutrition in that university. This department will exercise advisory functions in connection with the large scale farming operations of the company, and for some time its activities will consist mainly of experiments essential to the establishment of a sound basis for this advisory work, but it is announced that its primary object will be to conduct research in various branches of agricultural science and practise for the general welfare of British agriculture.

The British Forestry Conference at the meeting held recently in London passed a resolution in favor of the formation of an Empire Forestry Association, for the promotion and development of public interest in forestry throughout the empire, and also created an interim committee to consider ways and means. The committee appointed has drawn up proposals for circulation to all parts of the empire, for the establishment of a governing council for the association, and for the formation of an interim executive committee. The committee held that in view of the vast area embraced, the association's activities, apart from occasional conferences, must take a literary form. Its principal medium of communication would probably consist of a journal, issued quarterly. A publication of this kind, dealing with the needs, problems and progress of forestry in all parts of the empire, should, it is felt, be of interest and practical value to foresters, students of forestry and owners of woodlands, as well as the architects, engineers and traders interested in the distribution and use of timber.

Plans of the State Forestry Department for extensive reforestation in the woods and on the waste lands of Pennsylvania this year will call for the largest amount of seeds ever used and efforts are being made to secure as much as possible from indigenous trees. This will be the first time this work has been undertaken on such an extensive scale. As this is a year of heavy seed bearing by most of the species of forest trees unusually large quantities of seed will be collected from the various State forests. Any seed not planted in the four state forest tree nurseries next spring will be held over for planting the year following in case it is a lean seed year. While most of the seed to be collected will be used to grow young forest trees for planting on state lands and on private timber lands, some from deciduous trees will produce shade trees for free distribution to cities and boroughs for municipal and educational plantings.

A second edition of the *Index Generalis* of universities, university colleges, libraries, scientific institutes, museums, observatories, learned societies, etc., is being prepared. Particulars are accepted from all nationalities, and should be addressed to Professor R. de Montessus de Ballore, 56, Rue de Vaugirard, Paris (VI°).

The birth rate for the metropolitan area of Sydney, N. S. W., for 1919 was the lowest on record, being 14 per cent. below the average for the previous five years. The rate is equivalent to 23.05 per 1,000 of population. The decline in the birth rate since 1914 has been 5 per 1,000, but probably not all the decline can be attributed to the war, as the rate, after increasing from 1903 to 1912, declined slightly from 1912 to 1914. Illegitimate children numbered 7.41 per cent. of the total births, equivalent to 1.71 per 100 of population.

It is stated in the *Experiment Station Record* that the government of Argentina has recently offered additional scholarships in the agricultural schools of Casilda, Tucuman, Cordoba and Mendoza to young men of Peru

desiring to follow up their studies in Argentina. The municipal council of Buenos Aires, on December 22, 1919, passed an ordinance providing for the establishment of a practical school of aviculture in connection with the zoological garden. During the apprentice period pupils will be required to give their services to the school gratuitously. On the completion of the course a diploma as practical aviculturist will be given. In the Colombian Ministry of Agriculture a department of cattle and meat inspection has been established to study contagious cattle diseases and their remedies, and to inspect cattle and meat products intended for export to countries which demand certificates of inspection. A law of November 5, 1919, grants a subsidy of about $10,000 for the establishment of a course in agriculture and industries in the University of Nariño. The Department of Agriculture of Cuba has decided to establish a bureau of commercial information in European and American countries for the purpose of establishing cordial commercial relations between Cuba and the other countries. The first bureau will be established in France.

UNIVERSITY AND EDUCATIONAL NEWS

At a meeting of Messrs. Brunner, Mond, and Co., at Liverpool, on August 4, a resolution to authorize the directors to distribute to universities or other scientific institutions in the United Kingdom for the furtherance of scientific education and research, $500,000 out of the investment surplus reserve account was passed.

The University of Tennessee College of Medicine will erect a pathologic laboratory building to cost $75,000 near the Memphis General Hospital. This is in accordance with a contract between the university and the Memphis General Hospital by which the school has entire control of the teaching facilities in the hospital for a period of twenty years and the school will nominate the medical, surgical and laboratory staffs of the hospital.

Dr. Gilbert H. Cady, who has been connected with the Geological Survey of Illinois for several years and who has recently returned from a year spent in mining interests in the far east, has accepted the position of professor of geology and head of the department in the University of Arkansas. He also becomes state geologist of Arkansas.

At Northwestern University Miss Margaret Fuller, M.A., Chicago, has been appointed instructor in geology and Mr. Thomas Lloyd Gledhill, M.A., Toronto, has been appointed instructor in mineralogy and geology.

F. A. Varrelman, acting professor of botany at Occidental College, Los Angeles, during 1919–20 has accepted a professorship at the State Normal School, Silver City, New Mexico. Dr. F. A. Smiley will reassume the work in this department at Occidental College, having been at the University of California during the past year.

O. A. Haugen, formerly instructor at the University of Wisconsin is returning this fall as assistant professor of chemical engineering. He is at present connected with the Carborundrum company at Niagara Falls.

Dr. English Bagby has been appointed instructor in psychology at Yale University.

Dr. W. N. Haworth has been appointed to the chair of organic chemistry at Armstrong College, Newcastle-upon-Tyne, in succession to Professor S. Smiles.

DISCUSSION AND CORRESPONDENCE

THE OBLIGATION OF THE INVESTIGATOR TO THE LIBRARY

The dependence of the present-day investigator upon institutional libraries is almost absolute. Necessarily so, as only a very exceptional person can own, or provide room for, a library complete enough to cover the range of his professional interests. Even if he owned the books he could not care for them and do anything else. Except in his own special field, no investigator will attempt to compete with the skilled bibliographers of our better libraries, and even in his own field he is apt to appear at a disadvantage. One

of the most careful workers of my acquaintance recently located, after much search, the title of a somewhat obscure work on stomata, only to find, shortly after, that the book was plainly catalogued under the heading STOMATA in the library of the institution in which he was at work.

The work of the librarian is important to the investigator not only in making the results of previous researches available now, but in the attempt to insure present results being available in the future. If the results of the investigations of to-day are anywhere available to succeeding generations it will be in the larger libraries where the publications containing them are being carefully collected and catalogued. We have heard much recently about cooperation among investigators, its desirability, its difficulty, and its disadvantages, and the means by which its undesirable features may be avoided and its disadvantages and difficulties lessened. Might not brief consideration well be given to cooperation between the investigator and the most important of his co-laborers, a cooperation which can have neither difficulties nor disadvantages?

Those of us who are much in the field, perhaps, appreciate more keenly than those who are always in touch with their homes the special advantages of the public library. In these days of closed bars and crowded hotels the one place where the stranger is sure of a welcome is the public library. And, speaking seriously, the importance and influence in small communities of libraries as well stocked and well conducted as those of Poughkeepsie, New York, and Riverside, California, for example is hard to estimate. Now that Mr. Carnegie has provided these institutions all over the country with suitable buildings, in his commendable effort to die poor, why should not the investigator, who must die poor anyway, look to their contents?

The smaller public libraries need help especially in this particular. The almost overwhelming demand on these libraries for fiction, especially recent fiction, should not be permitted to exclude scientific material from their shelves. If the results of our labors, or the methods, or even the activities themselves, are to be made known to the reading public, as much of our literature as possible must be made available in public libraries. Every public library should have at least SCIENCE and the *Scientific Monthly*. If you find a library that lacks them, urge the authorities to subscribe, and if they lack the funds, give them your own set.

The investigator has, moreover, an obligation to the college library, the library of the college from which he graduated perhaps, or the one nearest his home. Other alumni will care for other interests, the pious for the erection of a new chapel, the more worldly minded for the gymnasium, but the library is too often left to shift for itself, and provided with insufficient funds. This applies particularly to the smaller colleges of course, but it is indeed a rare university library to which the average investigator can not add some volume in the course of ten years' work, and that volume will on the whole be much more useful and safer in a good library than in a private study or laboratory.

From the standpoint of self-interest as well as of common honesty, however, the first duty of the investigator is to the reference libraries, whether general libraries like the John Crerar Library and those of our leading universities, or libraries covering special fields such as the Lloyd Library or those connected with our large botanic gardens. If an investigator accepts the hospitality and uses the facilities of the Library of the Marine Biological Laboratory at Woods Hole, or that of Stanford University, and one is made quite at home in both without introduction, it seems no more than fair that these libraries be supplied in return with as complete a set as possible of his own publications if they lie within the field of interest of the library. I am reliably informed that this practise is by no means general. Comparatively few of the investigators of my acquaintance take the trouble to send reprints of their publications even to the Library of Congress.

That these papers are usually published in

standard periodicals, of which complete sets are supposedly available in these libraries does not cover the case. The United States at least is afflicted with several scientific periodicals of avowedly general nature, and some of the special journals have a none too stable editorial policy. Some of these special journals moreover still further complicate bibliographical work by permitting the publication of abstracts of work which at some time may be judged worthy of adequate publication, thus cluttering their indices beyond the point of convenience if not utility.

If then our libraries, even our special libraries, are to approximate completeness in their indices of current published scientific material they should have the assistance of the investigators themselves, at least to the extent of supplying them with such articles as are reprinted for private circulation. It is an almost universal custom for investigators to distribute reprints of their own papers among their colleagues. To add to these private mailing lists the names of the fifty leading libraries of this and other countries would mean some trouble and some slight expense. The time and cost thus involved would however be a very small fraction indeed of that expended in the prosecution and publication of the work and the insurance thus purchased that the papers would be cared for and made more available to this and succeeding generations would be well worth the investment.

Neil E. Stevens
Bureau of Plant Industry,
Washington, D. C.

THE FUR SEALS

To the Editor of Science: In an interesting and suggestive article on the "Rescued Fur Seal Industry" in Science for July 23, Mr. W. T. Hornaday states that "man's so-called management (of the herd) lies solely in the use of the seal killer's club and the skinning knife." This is not quite the whole truth, for while the behavior of individual animals in feeding, breeding, or migration is beyond human control, man can do something to increase the numbers. In the nineties, most of the young seals lying on sandy "rookeries" were killed by the hookworm (*Uncinaria lucasi*). Those on the rocks were virtually immune and as the shrinkage of the herd, before its rescue took them practically all off the sands, no "wormy pups" are lately reported. In 1897, the Commission of that year gather up—and mostly burned—12,000 "pups" that had been weakened by the hookworm and then trampled by the bulls. In that year we had several sandy patches in Zapadni rookery covered by rocks, and we suggested fencing the animals away from the great sand flat of Tolstoi. To cover or fence up sandy areas is a possible factor of "management."

Another is the extirpation of the "idle bulls" which surround the rookeries and raid the harems, killing many females and young. Ninety per cent. or more of the males of this polygamous species are wholly superfluous. In the recent absurdly needless "five years closed season" these have accumulated to the danger point. I am told that an order has now been given for the shooting of 7,000 of them.

The protection of the females from killing on land and sea may be also regarded as a phase of "management."

Whether other islands could be stocked from the Pribilofs has never been tested. On these islands there is ample breeding space for millions more, and there is no evidence of food shortage outside.

David Starr Jordan

A PRELIMINARY NOTE ON THE GERMINATION OF UROPHLYCTIS ALFALFÆ

Resting spores from decaying galls of alfalfa crown-wart have been observed to germinate in water cultures. The globose resting spores, depressed on one side, are 38–42 by 30 microns in diameter. They produce from one to fifteen or more zoosporangia which escape through irregular fissures in the brown walls. The zoosporangia vary in diameter from 10 to 40 microns. Zoospores leave the sporangia through short tubes projecting about 2 microns from the hyaline wall, with

an opening of about 2 microns in diameter. There are usually four or five tubes in large sporangia and one tube in small sporangia.

The zoospores are somewhat ovoid in form, 4 to 8 microns in length and very flexible. The single cilium, 30 to 50 microns in length, is attached at the broader posterior end and trails behind when the spore is actively swimming. There is usually one bright eyespot, but there may be two. Conjugation of zoospores has not been seen in my cultures.

Within twelve hours after leaving the sporangia most of the zoospores settle down at the margin of the hanging drop and become rounded in form. A single germ tube develops and grows out from the edge of the drop and along the surface of the cover glass. If the spore has come to rest too far from the margin, the mycelium grows downward and projects from the drop of water. The tube may reach a length of 10 to 20 microns in 24 hours after the zoospore has left the sporangium. The mycelium usually branches freely and irregularly after it reaches a length of about 10 microns. In cultures 9 days old the mycelium averaged about 20 microns in length. It varied from 10 to 60 microns (total length of branches).

Old galls are likely to contain nematodes, Paramœcium and other ciliate protozoa, several kinds of flagellates and amoeboid protozoa. Some of these feed on the zoospores, as many as 30 having been counted in a single Paramœcium. Cultures free from these organisms were obtained by transferring ripe sporangia, by means of a mechanically operated micropipette, into hanging drops of water. The zoospores escaped from the sporangia and sent out germ tubes in these cultures.

Much difficulty was encountered in finding galls with spores that would germinate. Even in such galls, only a very small percentage of the resting spores germinated. In some cases the zoospores escaped when the hyaline wall was extruded only slightly through the fissure in the brown wall. Usually the sporangium became entirely free before the spores were released.

Hanging drop cultures of spores from several galls produced sporangia for about two weeks. Attempts to hasten the release of zoospores by keeping these cultures on ice over night were not successful. Cultures containing sporangia were allowed to become partially dry for a few minutes and then moistened again. This effected the escape of zoospores from ripe sporangia. It did not change sporangia appreciably in which the contents had not become differentiated into spores.

Germination was obtained in November (1906) and in March, April, May, June and July (1920).

C. EMLEN SCOTT

BOTANICAL LABORATORY,
STANFORD UNIVERSITY,
CALIFORNIA

SCIENTIFIC BOOKS

Hand-List of Scientific Manuscripts in the British Isles dating from before the Sixteenth Century. By DOROTHEA WALEY SINGER. London, De La More Press, 1919. 8o. 12 pp.

Survey of Medical Manuscripts in the British Isles dating from before the Sixteenth Century. By DOROTHEA WALEY SINGER. London, J. Bale, Sons & Danielsson, Ltd., 1920, 8o, 12 pp.

These are important contributions to the early history of medieval medicine and science, the first fruits of a catalogue of some 30,000 scientific manuscripts of the Middle Ages, found in Britain, and now in preparation by Dr. Singer and his wife. The value of such a catalogue to future students will be incalculable, going forward as it does simultaneously with the cataloguing and intensive study of the scientific and medical incunabula. As the social and scientific history of modern medicine is to be found largely in the files of medical periodicals of the eighteenth to the twentieth centuries, so the unwritten history of medieval science is contained in the manuscripts, the pathway to which lies through the early printed books.

Until very recent years, the history of medieval science has been regarded with mingled feelings, whether of indifference or aversion, due to the fact that real knowledge of the subject, as based upon the elliptical data in the printed literature, is so meager as to be deceptive, while what little is known has been constantly misread, over-stated or misinterpreted, according to the religious bias of the expositors. Until Sudhoff began to photograph and interpret the hitherto undiscovered medical manuscripts on the continent of Europe, such valuable source-books of medieval folk-medicine as Oswald Cockayne's "Leechdoms, Wortcunning and Starcraft of Early England" (1864–6) remained undisturbed on the dustier shelves of libraries. But with the foundation of the Leipzig Institute (1905), things began to take a new turn. The classified hand-list of manuscripts which Dr. and Mrs. Singer are making is an important move in aid of the problem: "How are we to trace the disintegration of Greek science in the Middle Ages and the slow processes which led to the apparently sudden rise of the experimental method?" Before we can investigate the great mass of undigested manuscript material, we must first have a reasoned catalogue; while to catalogue all the manuscripts in a single country is the first step to a classified "world catalogue" of such manuscripts. Encouraged by grants from the Royal Society and the British Academy, the Singer catalogue has already progressed far enough to enable its compilers to block out their classification by subjects. This list of subjects, replete with such rubrics as Aristotle, Menology, Bestiaries, Magic, Cosmology, Herbaria, Lapidaries, Marvels, Melothesia Physiognomy, Cheiromancy, etc., already affords a glimpse into the medieval mind; and could we conceive of a medieval scientific library, public or private, as attaining to any great size (impossible by reason of the costliness of the illuminated manuscripts and printed incunabula), we should have an inkling of the probable arrangement of its books, by alcoves and shelves. Some 15,000 of these manuscripts are medical, and, of these, 1,900 are on general medicine, 953 alchemical, 600 magical, 194 surgical, 178 gynecological, 72 pediatric, 144 veterinary, 274 on pulse-lore, 274 on uroscopy, 234 on blood-letting, 144 on diet, 18 on fevers, 90 on the pest, 63 on the eye, 600 on herbs and simples, 114 on physiognomy and cheiromancy, 106 on generation, while no less than 669 are bestiaries and 2,500 collections of recipes. These figures at once give a better notion of the extent to which medicine was followed in the Middle Ages, than any existing lists of medical incunabula. Most of these manuscripts were written between 1200 and 1500 A.D., and but few before the eighth century. Mrs. Singer shows by curve-tracing their distribution in time, the curve taking an abrupt and constantly upward slope after the thirteenth century. The second paper (1920) concludes with a highly instructive set of 34 legends for lantern slides of specimen pages.

F. H. Garrison

Army Medical Museum

SPECIAL ARTICLES

THE ARRANGEMENT OF ATOMS IN SOME COMMON METALS

During the past year the crystal structures of several elementary substances have been determined. A brief summary of the results will be given here. Complete data will be published in the *Physical Review*.

The method is the same as that previously used.[1] A narrow beam of monochromatic X-rays is passed through the powdered material to be analyzed and produces on a photographic plate a pattern of fine lines. These lines are due to the reflection of the X-rays from the faces of the tiny crystals, one line for each kind of face. From the positions and intensities of the lines the crystal structure can be calculated.

CALCIUM

Calcium has generally been considered hexagonal, partly from analogy with magnesium

[1] *Phys. Rev.*, 10, 661, 1917; *Proc. A. I. E. E.*, 38, 1171, 1919. See also Debye & Sherrer, *Phys. Z.*, 18, 291, 483, 1917.

and zinc, and partly from a statement of Moissan[2] that it grows in hexagonal plates and rhombohedra.

The X-ray analysis shows it to be a perfect *face-centered cubic* arrangement of atoms, the side of the elementary cube being 5.56 Å. Each Ca atom is surrounded by 12 equidistant nearest neighbors, at distances of 3.93 Å.

TITANIUM

There is no crystallographic data regarding titanium. The X-ray analysis shows it to be a *centered cubic* arrangement, like chromium and iron. The side of the elementary cube is 3.144 Å. Each atom is surrounded by eight others, at distances of 2.72 Å.

ZINC

The arrangement of atoms in zinc is like that in magnesium, namely: *hexagonal close packed* (one of the two alternative arrangements that solid spheres assume when packed as closely as possible) except that it is elongated 14 per cent. in the direction of the hexagonal axis. The arrangement is that of *solid prolate spheroids in closest possible packing.*

Each atom is surrounded by six nearest neighbors, in its own plane, at distances of 2.67 Å, and by six others, three above and three below, at distances of 2.92 Å.

The observed axial ratio, 1.86, bears no simple relation to the value 1.356 found by crystallographers. The data on which the latter is based are, however, very unsatisfactory.

CADMIUM

The structure of cadmium is like that of zinc, namely: a *close packed arrangement of prolate spheroids.* The elongation of the spheroids is slightly greater than for zinc, viz., 16 per cent., corresponding to an axial ratio (ratio of altitude to side of elementary hexagonal prism) of 1.89.

Each atom has six nearest neighbors in its own plane at distances of 2.98 Å., and six others almost as near, three above and three below, at distances of 3.30 Å.

[2] See Groth, Chemische Krystallographie.

As in the case of zinc the observed axial ratio, 1.89, bears no obvious relation to the crystallographer's value, 1.335.

INDIUM

The atoms of indium are arranged in a *face-centered tetragonal lattice.* The axial ratio, that is, the ratio of altitude to base of the elementary tetragonal prism, is 1.06. The lattice is therefore like "cubic close packing" except that it is elongated 6 per cent. in the direction of one of the cubic axes. *It is a close-packed arrangement for prolate spheroids,* alternative with the zinc and cadmium type.

The side of the elementary prism is 4.58 Å., and its height 4.86 Å. Each indium atom has four nearest neighbors at distances of 3.24 Å., and eight others, four above and four below, at distances of 3.33 Å.

The crystallographic data assigned indium to the cubic system.

RUTHENIUM

The arrangement of atoms in ruthenium, like that in zinc and cadmium, is very close to *hexagonal close packing.* In this case, however, the lattice is *shortened* in the direction of the hexagonal axis by 3 per cent., giving an axial ratio of 1.59. *This is a close-packed arrangement for oblate spheroids.*

Each ruthenium atom is surrounded by six, in its own plane, at distance of 2,686Å., and by six others, three above and three below, at distances of 2.640 Å.

PALLADIUM

The atoms of palladium are in *face-centered cubic* arrangement. This is the "cubic close packed" arrangement for perfect spheres.

The side of the elementary cube is 3.92 Å. Each atom is surrounded by twelve equidistant neighbors at distances of 2.77 Å.

TANTALUM

The atoms of tantalum are in *centered cubic* arrangement, like tungsten. The side of the elementary cube is 3.272 Å. Each atom is surrounded by eight nearest neighbors at distances of 2.83 Å.

IRIDIUM

The atoms of iridium, like platinum, are in *face-centered cubic* arrangement.

The side of the elementary cube is 3.80 Å., and the distance from one atom to each of its twelve nearest neighbors 2.69 Å.

Albert W. Hull
Schenectady

EFFECTS PRODUCED BY X-RAY ENERGY ACTING UPON FROGS' OVA IN EARLY DEVELOPMENTAL STAGES

Several interesting and possibly significant facts were ascertained, in connection with the general study of the action of X-ray energy upon the fertilized frogs' ovum, through raying the entire egg at different developmental stages up to the time of closure of the neural tube. Because of the chemical and physical ontogenetic processes involving both proanlagen constituents, enzyme and nutritive, and immediately anticipating the morphologic features of differentiation, it was supposed that these substances must show a variable degree of absorption of energy dependent upon the stage of development. When the quantity of energy utilized remained constant, the defects produced should vary with the stage rayed. One might anticipate both gross and microscopic morphologic variations in the developed embryos. The results of this experiment, however, are precisely of the reverse nature.

The eggs were permitted to develop in the ponds where they were laid until the proper stage of development had been reached, whereupon they were brought immediately into the laboratory and rayed. Development was permitted to progress in glass jars of a capacity of 1,000 c.c., the water being changed frequently. Of the 300 eggs used for the experiment, upwards of fifty were sectioned serially. The embryos were fixed in formalin after Schultze's method at varying intervals after raying. None, however, was permitted to develop to the time of metamorphosis. In all of the experiments the distance from the target to the eggs and the per-second energy output of the tube were constant as was also the time of exposure. The tube carried a current strength of 50 milliamperes at 50 K.V. A dosage of 100 mam. was given to each group of from twenty to twenty-five eggs. These were placed 17.5 cm. from the target. The different groups represented approximately every developmental stage from the two-cell to the period of the closure of the neural tube. No attempt was made to orient the eggs with reference to the tube so that the animal pole or the vegetable pole or right side or left side of the embryos should be uppermost.

Contrary to what one might at first anticipate, the developed embryos were identical in every gross and microscopic detail to those produced by raying the whole ovum at the two-cell stage as described by the author in the *Anatomical Record* of November, 1919. This uniformity of results, irrespective of the stage rayed, is the most striking feature of the experiment. Sections of these embryos resemble in every histological detail those produced by the former method, and could serve very well to illustrate the results of that investigation. Since the author has already given these details, it would be superfluous to duplicate that description in this paper. The experiment represents, therefore, still another method by means of which a standardized, defective, morphologic condition may be produced.

Owing chiefly to our present lack of knowledge of the association of chemical formula with morphologic structure in the ovum, a completely satisfactory explanation of this phenomenon can not be given. Before such may be attempted, prolonged experimentation along this line must necessarily be carried out. This represents merely one step in the experimental analysis of the ovum and whatever conclusions are drawn from the phenomenon produced must be based very largely upon hypothesis.

The factors concerned fall into two natural categories, one embryological and the other chemical or physical, *i. e.*, one dealing with the embryological mechanism affected, and the other with the nature of the change produced in the physical and chemical constitution of the ovum. Granting the presence of a series of chemical ontogenetic modifications preceding

the known morphologic features of cell differentiation, it is not impossible that one and the same molecule whether falling in the category of proanlagen nutritive or enzymatic substance might, regardless of the oxidative or reductive changes incident to its elaboration, show the same capacity of absorption of energy in the two-cell stage as in the gastrula no neural-plate stages. A constant and uniform alteration of this molecule might be assumed to lead to a correspondingly constant and uniform embryological result. To the mind of the author, however, this assumption appears less probable than the hypothesis that certain protoplasmic substances maintain a constant structure, both physical and chemical, during the early stages of ontogeny. It argues equally well for the results produced whether we determine the nature of this constant content to be nutritive or enzyme, since it is conceivable that the deprivation of the enzymes of the substances out of which the morphological structures of differentiation are formed would lead to the same developmental result as the inhibitive effect of energy acting upon the ferments themselves. The presence of retardation effects is well attested both by this and by the earlier experiment and might well be accounted for on these grounds.

It is significant that in these specimens there is an absence of evidence pointing towards the destruction either of protoplasmic or of nuclear material. A more severe degree of injury brought about by the use of a greater amount of energy was evident through the presence of both protoplasmic and nuclear detritus. Furthermore, it must be pointed out that the change brought about is not incompatible with the vitality of the cells. There appears to have been suspended apparently the function of but one physiological factor of cell development, that of differentiation, unattended by any morphologic indication of destruction. The precise nature and location of this alteration, if morphologic, can not at present be identified.

W. M. Baldwin

Union University Medical College,
Albany, N. Y.

THE AMERICAN CHEMICAL SOCIETY. V

DIVISION OF INDUSTRIAL CHEMISTS AND CHEMICAL ENGINEERS

H. D. Batchelor, *chairman*

H. E. Howe, *secretary*

The symposium on cellulose chemistry attracted considerable attention and it was voted to hold a second symposium at the time of the autumn meeting in Chicago. The purpose of these symposia is to determine whether the formation of a section of Cellulose Chemistry within the society is feasible, some seventy-five members having expressed themselves in favor of such a project in discussing the matter by correspondence. The question of specifications for reagent chemicals and the standardization of laboratory apparatus and instruments brought out a number of valuable contributions, both from manufacturers and consumers, indicating willingness on the part of all concerned to cooperate in bringing about the standardization which is recognized as necessary. The subject of stimulating research in pure and applied chemistry and devising an incentive to such research gave rise to a lengthy discussion in which the economic status of the chemist was brought in. The present situation with reference to professors and instructors was discussed at length, involving the conditions for research in the various institutions and what might be done toward improving circumstances. The result of Dr. Comey's investigation would seem to indicate that at present the chemist is being as well paid for his services on the average as are the members of any of the other professions and that those in responsible positions in industry have shown a remarkable advance in earning power during the last few years. At the September meeting a symposium on the conservation and utilization of fuel will be held in addition to the symposium on cellulose chemistry and general papers.

Mechanism of the reactions of cellulose: Jessie E. Minor. The charge upon the cellulose is the result of the selective adsorption of the ions of an electrolyte by means of the residual valence which certain atoms or groups of atoms upon the surface of the colloid are capable of exerting. The subsequent swelling of a colloid in the presence of acids and bases is due to the absorption of water by the colloid as a result of a dialyzing or a repulsive force associated with the presence of the electrolyte ion. The hydration of cellulose is due

to the swelling of the colloidal cellulose which has received an electrolytic charge from the hydroxyl ions in the water in which it is immersed. The hydrolysis is the direct result of the presence of the electrolyte ions whose primary effect had been hydration. The formation of oxycellulose is probably preceded by the hydrolysis of the cellulose whereby the CO group is rendered more attackable for the oxygen. The solution by zinc chloride is due to the peptization of the cellulose by the adsorbed ions with the formation of a viscous emulsion. The union between cellulose and dye is due primarily to adsorption.

The determination of cellulose in woods: S. A. MAHOOD. A uniform size of particle appears to be essential if comparable results are to be obtained in the determination of cellulose in woods. Material which passes an 80-mesh standard sieve but is retained on a 100-mesh sieve has been found to be most satisfactory from the standpoint of both yield and manipulation. Material obtained by a single mechanical process of disintegration may give a sample on sifting which is not representative. To avoid this a combination of two processes, sawing and grinding, has been used. The apparatus recommended by Sieber and Walter for use in chlorination appears to give a lower yield of cellulose than the original Cross and Bevan method probably because of the temperature at which chlorination takes place.

Nitrocellulose from wood pulp: R. G. WOODBRIDGE, JR. Due to shortage of cotton, Germany was obliged early in the world war to use wood cellulose in place of cotton for making smokeless powder. Up to about July, 1918, it was not anticipated that any wood cellulose would be required in the U. S. in spite of the enormous production of smokeless powder proposed for the balance of 1918 and for the year 1919. However, the shortage in the cotton crop, due to the drought in the summer of 1918, would have made it necessary to have supplemented the short-fibered cotton by wood pulp had the war continued. This emergency had been foreseen and experiments had been in progress for several years on the question of nitrating wood cellulose for smokeless powder manufacture. These experiments showed that a mixture of cotton and wood pulp containing up to 50 per cent. of the latter could be nitrated, purified and made into smokeless powder without any important change in equipment, with no serious loss in production, and with no change in the quality of the smokeless powder.

Notes on the manufacture of nitrocellulose: J. O. SMALL and C. A. HIGGIN. In selecting a cellulose to be used for nitrating, attention should be given to both its chemical and physical properties. The biological character of the crude fiber and its purification are the chief factors influencing the chemical properties of a cellulose, while the physical properties comprise cleanliness, color and type of fiber. From the chemical analysis of a cellulose much may be learned concerning previous treatments and its subsequent behavior when nitrated. The most important tests are (1) solubility in sodium or potassium hydroxide, (2) furfural content, (3) ether-extractive matter. Nitrocellulose for explosives must pass rigid stability tests. Purification treatments of long duration are often necessary. Since the cotton fiber is hollow, pulping is necessary to remove the last traces of acid, while alcohol dehydration improves stability by the solution of the lower nitrated, unstable types. In the non-explosive arts the most common effects of instability are the formation of a brittle film, discoloration of dyes and corrosion in metal lacquers. By the use of alkaline treatments following an acid hydrolysis, better stability may be obtained without impairing the appearance of the nitrocellulose solution.

Certain aspects of the chemistry of cellulose acetate from the colloidal viewpoint: G. J. ESSELEN. Considering cellulose as a colloidal aggregate, certain of the changes involved in the preparation and use of cellulose acetate are considered from the colloidal viewpoint. With these considerations as a basis, a theory is offered to explain a number of previously unconnected facts regarding the solubility of cellulose acetate.

Projects of the preliminary committee on American cotton research: H. E. HOWE.

Is it advisable to form a section of cellulose chemistry? JASPER E. CRANE.

The determination of cellulose in woods: L. F. HAWLEY. A uniform size of particle appears to be essential if comparable results are to be obtained in the determination of cellulose in woods. Material which passes an 80-mesh standard sieve but is retained on a 100-mesh sieve has been found to be most satisfactory from the standpoint of both yield and manipulation. Material obtained by a single mechanical process of disintegration may give a sample on sifting which is not representative. To avoid this a combination of two processes, sawing and grinding, has been used. The apparatus recommended by Sieber and Walter

for use in chlorination appears to give a lower yield of cellulose than the original Cross and Bevan method probably because of the temperature at which chlorination takes place.

Cellulose phthalate; its preparation and properties: H. A. Levey.

The effect of impurities on the metallurgy of tungsten: Clarence W. Botka. A study was made of the effect of such oxides as those of iron, cobalt, calcium, sodium, aluminum, magnesium, thorium and the rare earths on the density of ignited tungsten oxide and of the tungsten metal powder resulting from its reduction in hydrogen. Further observation was made of the effect of these impurities upon the grain size of sintered tungsten ingots. In general it may be said that iron and cobalt render the metal exceedingly hard and difficult to work, and produce an exaggerated grain growth. Such impurities as the oxides of calcium, aluminum, magnesium, etc., tend to block grain growth during sintering and in some instances make it necessary to prolong this operation.

The separation and examination of the isomers of xylene: W. D. Turner and K. K. Kershner. Samples of xylene, obtained through the kindness of the Laclede Gas Light Co. were submitted to a series of fractional sulphonations and crystallizations of various sulphonic salts, according to a scheme suggested by the research department of the Eastman Kodak Co. The processes were first carried out in glassware after which the resulting modifications were tried in small size industrial apparatus. The process as applied consisted essentially of four successive sulphonations, the oil remaining unaffected holding the para-xylene. This was sulphonated with fuming sulphuric acid and converted to the barium salt for recrystallization after which it yielded pure para-xylene by hydrolysis. The ortho- and meta-sulphonic acids were converted to the sodium salts which were separated by fractional crystallization. Subsequent hydrolysis yielded pure ortho- and meta-xylenes.

The preparation of furfural from corn cobs: H. L. Dunlap and V. K. Fischlowitz. Varying concentrations of sulfuric acid, from 5.8 normal to 1 normal, were used to treat the material in a thirty-five gallon enameled steam jacketed kettle. Three normal sulfuric acid was found to be best. Concentrations beyond this decomposes some of the furfural thus cutting down the yield. When rapid steam distillation was used, the time for refluxing is about two hours. The more rapid the steam distillation the better, as the furfural will be carried over in larger quantities for the distillate collected. If the distillation is too long drawn out, poorer yields will result owing to decomposition. The liquid in the kettle must not be allowed to concentrate too rapidly in the beginning of the distillation. Sulfuric acid does not serve as well as hydrochloric acid for the condensation of the pentoses, but it permits of the use of condensers other than of glass. Benzene can be used as a solvent in place of the more expensive and more highly volatile ether.

The carbonisation of Missouri cannel coals: H. L. Dunlap and K. K. Kerschner. Five different cannel coals were subjected to destructive distillation in a gas-fired horizontal retort and the results compared with a bituminous coal coked under the same conditions. Both the oils and gases collected at different stages of the carbonization were examined. Different cannel coals show a wide variation in the yield of distillation products. The decomposition temperature for cannel coals is much lower than that of bituminous coals. The oils from cannel coals have a low specific gravity and consist chiefly of paraffin hydrocarbons. These oils resemble the oils obtained by low-temperature carbonization of bituminous coals. Cannel coals yield a larger quantity of gas than bituminous coals and this gas has a high calorific and illuminating value. Again, this is what is found in the coking bituminous coals at a low temperature. With the removal of the sulfur compounds, cannel coal gas would be a valuable illuminating gas. Cannel coals yield little ammonia due to the low temperature of carbonization. Only two of the coals examined gave a coke of any commercial value. Again, these coals would not be a source for benzene and toluene unless coked at a higher temperature than used in these tests.

(To be continued)

Charles L. Parsons,
Secretary

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

Friday, September 10, 1920

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE INTERNAL CONSTITUTION OF THE STARS[1]

Last year at Bournemouth we listened to a proposal from the president of the association to bore a hole in the crust of the earth and discover the conditions deep down below the surface. This proposal may remind us that the most secret places of nature are, perhaps, not 10 to the n-th miles above our heads, but 10 miles below our feet. In the last five years the outward march of astronomical discovery has been rapid, and the most remote worlds are now scarcely safe from its inquisition. By the work of H. Shapley the globular clusters, which are found to be at distances scarcely dreamed of hitherto, have been explored, and our knowledge of them is in some respects more complete than that of the local aggregation of stars which includes the sun. Distance lends not enchantment but precision to the view. Moreover, theoretical researches of Einstein and Weyl make it probable that the space which remains beyond is not illimitable; not merely the material universe, but space itself, is perhaps finite; and the explorer must one day stay his conquering march for lack of fresh realms to invade. But to-day let us turn our thoughts inwards to that other region of mystery—a region cut off by more substantial barriers, for, contrary to many anticipations, even the discovery of the fourth dimension has not enabled us to get at the inside of a body. Science has material and non-material appliances to bore into the interior, and I have chosen to devote this address to what may be described as analytical boring devices—*absit omen!*

The analytical appliance is delicate at present, and, I fear, would make little headway against the solid crust of the earth. Instead

[1] Address before the Mathematical and Physical Science Section of the British Association for the Advancement of Science.

of letting it blunt itself against the rocks, let us look round for something easier to penetrate. The sun? Well, perhaps. Many have struggled to penetrate the mystery of the interior of the sun; but the difficulties are great, for its substance is denser than water. It may not be quite so bad as Biron makes out in "Love's Labour's Lost":

> The heaven's glorious sun;
> That will not be deep-searched with saucy looks;
> Small have continual plodders ever won
> Save base authority from others' books.

But it is far better if we can deal with matter in that state known as a perfect gas, which charms away difficulties as by magic. Where shall it be found?

A few years ago we should have been puzzled to say where, except perhaps in certain nebulæ; but now it is known that abundant material of this kind awaits investigation. Stars in a truly gaseous state exist in great numbers, although at first sight they are scarcely to be discriminated from dense stars like our sun. Not only so, but the gaseous stars are the most powerful light-givers, so that they force themselves on our attention. Many of the familiar stars are of this kind—Aldebaran, Canopus, Arcturus, Antares; and it would be safe to say that three quarters of the naked-eye stars are in this diffuse state. This remarkable condition has been made known through the researches of H. N. Russell and E. Hertzsprung; the way in which their conclusions, which ran counter to the prevailing thought of the time, have been substantiated on all sides by overwhelming evidence, is the outstanding feature of recent progress in stellar astronomy.

The diffuse gaseous stars are called *giants*, and the dense stars are called *dwarfs*. During the life of a star there is presumably a gradual increase of density through contraction, so that these terms distinguish the earlier and later stages of stellar history. It appears that a star begins its effective life as a giant of comparatively low temperature—a red or M-type star. As this diffuse mass of gas contracts its temperature must rise, a conclusion long ago pointed out by Homer Lane. The rise continues until the star becomes too dense, and ceases to behave as a perfect gas. A maximum temperature is attained, depending on the mass, after which the star, which has now become a dwarf, cools and further contracts. Thus each temperature-level is passed through twice, once in an ascending and once in a descending stage—once as a giant, once as a dwarf. Temperature plays so predominant a part in the usual spectral classification that the ascending and descending stars were not originally discriminated, and the customary classification led to some perplexities. The separation of the two series was discovered through their great difference in luminosity, particularly striking in the case of the red and yellow stars, where the two stages fall widely apart in the star's history. The bloated giant has a far larger surface than the compact dwarf, and gives correspondingly greater light. The distinction was also revealed by direct determinations of stellar densities, which are possible in the case of eclipsing variables like Algol. Finally, Adams and Kohlschütter have set the seal on this discussion by showing that there are actual spectral differences between the ascending and descending stars at the same temperature-level, which are conspicuous enough—when they are looked for.

Perhaps we should not too hastily assume that the direction of evolution is necessarily in the order of increasing density, in view of our ignorance of the origin of a star's heat, to which I must allude later. But, at any rate, it is a great advance to have disentangled what is the true order of continuous increase of density, which was hidden by superficial resemblances.

The giant stars, representing the first half of a star's life, are taken as material for our first boring experiment. Probably, measured in time, this stage corresponds to much less than half the life, for here it is the ascent which is easy and the way down is long and slow. Let us try to picture the conditions inside a giant star. We need not dwell on the vast dimensions—a mass like that of the sun, but swollen to much greater volume on account of the low density, often below that of our own atmos-

phere. It is the star as a storehouse of heat which especially engages our attention. In the hot bodies familiar to us the heat consists in the energy of motion of the ultimate particles, flying at great speeds hither and thither. So too in the stars a great store of heat exists in this form; but a new feature arises. A large proportion, sometimes more than half the total heat, consists of imprisoned radiant energy—ether-waves travelling in all directions trying to break through the material which encages them. The star is like a sieve, which can only retain them temporarily; they are turned aside, scattered, absorbed for a moment, and flung out again in a new direction. An element of energy may thread the maze for hundreds of years before it attains the freedom of outer space. Nevertheless the sieve leaks, and a steady stream permeates outwards, supplying the light and heat which the star radiates all round.

That some ethereal heat as well as material heat exists in any hot body would naturally be admitted; but the point on which we have here to lay stress is that in the stars, particularly in the giant stars, the ethereal portion rises to an importance which quite transcends our ordinary experience, so that we are confronted with a new type of problem. In a red-hot mass of iron the ethereal energy constitutes less than a billionth part of the whole; but in the tussle between matter and ether the ether gains a larger and larger proportion of the energy as the temperature rises. This change in proportion is rapid, the ethereal energy increasing rigorously as the fourth power of the temperature, and the material energy roughly as the first power. But even at the temperature of some millions of degrees attained inside the stars there would still remain a great disproportion; and it is the low density of material, and accordingly reduced material energy per unit volume in the giant stars, which wipes out the last few powers of 10. In all the giant stars known to us, widely as they differ from one another, the conditions are just reached at which these two varieties of heat-energy have attained a rough equality; at any rate one can not be neglected compared with the other. Theoretically there could be conditions in which the disproportion was reversed and the ethereal far out-weighed the material energy; but we do not find them in the stars. It is as though the stars had been measured out—that their sizes had been determined—with a view to this balance of power; and one can not refrain from attributing to this condition a deep significance in the evolution of the cosmos into separate stars.

. . . .

Study of the radiation and internal conditions of a star brings forward very pressingly a problem often debated in this section: What is the source of the heat which the sun and stars are continually squandering? The answer given is almost unanimous—that it is obtained from the gravitational energy converted as the star steadily contracts. But almost as unanimously this answer is ignored in its practical consequences. Lord Kelvin showed that this hypothesis, due to Helmholtz, necessarily dates the birth of the sun about 20,000,000 years ago; and he made strenuous efforts to induce geologists and biologists to accommodate their demands to this time-scale. I do not think they proved altogether tractable. But it is among his own colleagues, physicists and astronomers, that the most outrageous violations of this limit have prevailed. I need only refer to Sir George Darwin's theory of the earth-moon system, to the present Lord Rayleigh's determination of the age of terrestrial rocks from occluded helium, and to all modern discussions of the statistical equilibrium of the stellar system. No one seems to have any hesitation, if it suits him, in carrying back the history of the earth long before the supposed date of formation of the solar system; and in some cases at least this appears to be justified by experimental evidence which it is difficult to dispute. Lord Kelvin's date of the creation of the sun is treated with no more respect than Archbishop Ussher's.

The serious consequences of this contraction hypothesis are particularly prominent in the case of giant stars, for the giants are prodigal

with their heat and radiate at least a hundred times as fast as the sun. The supply of energy which suffices to maintain the sun for 10,000,000 years would be squandered by a giant star in less than 100,000 years. The whole evolution in the giant stage would have to be very rapid. In 18,000 years at the most a typical star must pass from the initial M stage to type G. In 80,000 years it has reached type A, near the top of the scale, and is about to start on the downward path. Even these figures are probably very much overestimated. Most of the naked-eye stars are still in the giant stage. Dare we believe that they were all formed within the last 80,000 years? The telescope reveals to us objects not only remote in distance but remote in time. We can turn it on a globular cluster and behold what was passing 20,000, 50,000, even 200,000 years ago—unfortunately not all in the same cluster, but different clusters representing different epochs of the past. As Shapley has pointed out, the verdict appears to be "no change." This is perhaps not conclusive, because it does not follow that individual stars have suffered no change in the interval; but it is difficult to resist the impression that the evolution of the stellar universe proceeds at a slow, majestic pace, with respect to which these periods of time are insignificant.

There is another line of astronomical evidence which appears to show more definitely that the evolution of the stars proceeds far more slowly than the contraction hypothesis allows; and perhaps it may ultimately enable us to measure the true rate of progress. There are certain stars, known as Cepheid variables, which undergo a regular fluctuation of light of a characteristic kind, generally with a period of a few days. This light change is *not* due to eclipse. Moreover, the color quality of the light changes between maximum and minimum, evidently pointing to a periodic change in the physical condition of the star. Although these objects were formerly thought to be double stars, it now seems clear that this was a misinterpretation of the spectroscopic evidence. There is in fact no room for the hypothetical companion star; the orbit is so small that we should have to place it inside the principal star. Everything points to the period of the light pulsation being something intrinsic in the star; and the hypothesis advocated by Shapley, that it represents a mechanical pulsation of the star, seems to be the most plausible. I have already mentioned that the observed period does in fact agree with the calculated period of mechanical pulsation, so that the pulsation explanation survives one fairly stringent test. But whatever the cause of the variability, whether pulsation or rotation, provided only that it is intrinsic in the star, and not forced from outside, the density must be the leading factor in determining the period. If the star is contracting so that its density changes appreciably, the period can not remain constant. Now, on the contraction hypothesis the change of density must amount to at least 1 per cent. in 40 years. (I give the figures for δ Cephei, the best-known variable of this class.) The corresponding change of period should be very easily detectable. For δ Cephei the period ought to decrease 40 seconds annually.

Now δ Cephei has been under careful observation since 1785, and it is known that the change of period, if any, must be very small. S. Chandler found a decrease of period of 1/20 second per annum, and in a recent investigation E. Hertzsprung has found a decrease of 1/10 second per annum. The evidence that there is any decrease at all rests almost entirely on the earliest observations made before 1800, so that it is not very certain; but in any case the evolution is proceeding at not more than 1/400 of the rate required by the contraction hypothesis. There must at this stage of the evolution of the star be some other source of energy which prolongs the life of the star 400-fold. The time-scale so enlarged would suffice for practically all reasonable demands.

I hope the dilemma is plain. Either we must admit that whilst the density changes 1 per cent, a certain period intrinsic in the star can change no more than 1/400 of 1 per cent., or we must give up the contraction hypothesis.

If the contraction theory were proposed today as a novel hypothesis I do not think it would stand the smallest chance of acceptance. From all sides—biology, geology, physics, astronomy—it would be objected that the suggested source of energy was hopelessly inadequate to provide the heat spent during the necessary time of evolution; and, so far as it is possible to interpret observational evidence confidently, the theory would be held to be definitely negative. Only the inertia of tradition keeps the contraction hypothesis alive—or rather, not alive, but an unburied corpse. But if we decide to inter the corpse, let us frankly recognize the position in which we are left. A star is drawing on some vast reservoir of energy by means unknown to us. This reservoir can scarcely be other than the sub-atomic energy which, it is known, exists abundantly in all matter; we sometimes dream that man will one day learn how to release it and use is for his service. The store is well-nigh inexhaustible, if only it could be tapped. There is sufficient in the sun to maintain its output of heat for 15 billion years.

Certain physical investigations in the past year, which I hope we may hear about at this meeting, make it probable to my mind that some portion of this sub-atomic energy is actually being set free in the stars. F. W. Aston's experiments seem to leave no room for doubt that all the elements are constituted out of hydrogen atoms bound together with negative electrons. The nucleus of the helium atom, for example, consists of 4 hydrogen atoms bound with 2 electrons. But Aston has further shown conclusively that the mass of the helium atom is less than the sum of the masses of the 4 hydrogen atoms which enter into it; and in this at any rate the chemists agree with him. There is a loss of mass in the synthesis amounting to about 1 part in 120, the atomic weight of hydrogen being 1.008 and that of helium just 4. I will not dwell on his beautiful proof of this, as you will no doubt be able to hear it from himself. Now mass can not be annihilated, and the deficit can only represent the mass of the electrical energy set free in the transmutation. We can therefore at once calculate the quantity of energy liberated when helium is made out of hydrogen. If 5 per cent, of a star's mass consists initially of hydrogen atoms, which are gradually being combined to form more complex elements, the total heat liberated will more than suffice for our demands, and we need look no further for the source of a star's energy.

But is it possible to admit that such a transmutation is occurring? It is difficult to assert, but perhaps more difficult to deny, that this is going on. Sir Ernest Rutherford has recently been breaking down the atoms of oxygen and nitrogen, driving out an isotope of helium from them; and what is possible in the Cavendish laboratory may not be too difficult in the sun. I think that the suspicion has been generally entertained that the stars are the crucibles in which the lighter atoms which abound in the nebulæ are compounded into more complex elements. In the stars matter has its preliminary brewing to prepare the greater variety of elements which are needed for a world of life. The radio-active elements must have been formed at no very distant date; and their synthesis, unlike the generation of helium from hydrogen, is endothermic. If combinations requiring the addition of energy can occur in the stars, combinations which liberate energy ought not to be impossible.

We need not bind ourselves to the formation of helium from hydrogen as the sole reaction which supplies the energy, although it would seem that the further stages in building up the elements involve much less liberation, and sometimes even absorption, of energy. It is a question of accurate measurement of the deviations of atomic weights from integers, and up to the present hydrogen is the only element for which Mr. Aston has been able to detect the deviation. No doubt we shall learn more about the possibilities in due time. The position may be summarized in these terms: the atoms of all elements are built of hydrogen atoms bound together, and presumably have at one time been formed

from hydrogen; the interior of a star seems as likely a place as any for the evolution to have occurred; whenever it did occur a great amount of energy must have been set free; in a star a vast quantity of energy is being set free which is hitherto unaccounted for. You may draw a conclusion if you like.

If, indeed, the sub-atomic energy in the stars is being freely used to maintain their great furnaces, it seems to bring a little nearer to fulfilment our dream of controlling this latent power for the well-being of the human race—or for its suicide.

So far as the immediate needs of astronomy are concerned, it is not of any great consequence whether in this suggestion we have actually laid a finger on the true source of the heat. It is sufficient if the discussion opens our eyes to the wider possibilities. We can get rid of the obsession that there is no other conceivable supply besides contraction, but we need not again cramp ourselves by adopting prematurely what is perhaps a still wilder guess. Rather we should admit that the source is not certainly known, and seek for any possible astronomical evidence which may help to define its necessary character. One piece of evidence of this kind may be worth mentioning. It seems clear that it must be the high temperature inside the stars which determines the liberation of energy, as H. N. Russell has pointed out. If so the supply may come mainly from the hottest region at the center. I have already stated that the general uniformity of the opacity of the stars is much more easily intelligible if it depends on scattering rather than on true absorption; but it did not seem possible to reconcile the deduced stellar opacity with the theoretical scattering coefficient. Within reasonable limits it makes no great difference in our calculations at what parts of the star the heat energy is supplied, and it was assumed that it comes more or less evenly from all parts, as would be the case on the contraction theory. The possibility was scarcely contemplated that the energy is supplied entirely in a restricted region round the center. Now, the more concentrated the supply, the lower is the opacity requisite to account for the observed radiation. I have not made any detailed calculations, but it seems possible that for a sufficiently concentrated source the deduced and the theoretical coefficients could be made to agree, and there does not seem to be any other way of accomplishing this. Conversely, we might perhaps argue that the present discrepancy of the coefficients shows that the energy supply is not spread out in the way required by the contraction hypothesis, but belongs to some new source only available at the hottest, central part of the star.

I should not be surprised if it is whispered that this address has at times verged on being a little bit speculative; perhaps some outspoken friend may bluntly say that it has been highly speculative from beginning to end. I wonder what is the touchstone by which we may test the legitimate development of scientific theory and reject the idly speculative. We all know of theories which the scientific mind instinctively rejects as fruitless guesses; but it is difficult to specify their exact defect or to supply a rule which will show us when we ourselves do err. It is often supposed that to speculate and to make hypotheses are the same thing; but more often they are opposed. It is when we let our thoughts stray outside venerable, but sometimes insecure, hypotheses that we are said to speculate. Hypothesis limits speculation. Moreover, distrust of speculation often serves as a cover for loose thinking; wild ideas take anchorage in our minds and influence our outlook; whilst it is considered too speculative to subject them to the scientific scrutiny which would exercise them.

If we are not content with the dull accumulation of experimental facts, if we make any deductions or generalizations, if we seek for any theory to guide us, some degree of speculation can not be avoided. Some will prefer to take the interpretation which seems to be most immediately indicated and at once adopt that as an hypothesis; others will rather seek to explore and classify the widest possibilities which are not definitely inconsistent with the facts. Either choice has its dangers; the first

may be too narrow a view and lead progress into a cul-de-sac; the second may be so broad that it is useless as a guide, and diverges indefinitely from experimental knowledge. When this last case happens, it must be concluded that the knowledge is not yet ripe for theoretical treatment and speculation is premature. The time when speculative theory and observational research may profitably go hand in hand is when the possibilities, or at any rate the probabilities, can be narrowed down by experiment, and the theory can indicate the tests by which the remaining wrong paths may be blocked up one by one.

The mathematical physicist is in a position of peculiar difficulty. He may work out the behavior of an ideal model of material with specifically defined properties, obeying mathematically exact laws, and so far his work is unimpeachable. It is no more speculative than the binomial theorem. But when he claims a serious interest for his toy, when he suggests that his model is like something going on in Nature, he inevitably begins to speculate. Is the actual body really like the ideal model? May not other unknown conditions intervene? He can not be sure, but he can not suppress the comparison; for it is by looking continually to Nature that he is guided in his choice of a subject. A common fault, to which he must often plead guilty, is to use for the comparison data over which the more experienced observer shakes his head; they are too insecure to build extensively upon. Yet even in this, theory may help observation by showing the kind of data which it is especially important to improve.

I think that the more idle kinds of speculation will be avoided if the investigation is conducted from the right point of view. When the properties of an ideal model have been worked out by rigorous mathematics, all the underlying assumptions being clearly understood, then it becomes possible to say that such properties and laws lead precisely to such and such effects. If any other disregarded factors are present, they should now betray themselves when a comparison is made with Nature. There is no need for disappointment at the failure of the model to give perfect agreement with observation; it has served its purpose, for it has distinguished what are the features of the actual phenomena which require new conditions for their explanation. A general preliminary agreement with observation is necessary, otherwise the model is hopeless; not that it is necessarily wrong so far as it goes, but it has evidently put the less essential properties foremost. We have been pulling at the wrong end of the tangle, which has to be unravelled by a different approach. But after a general agreement with observation it established, and the tangle begins to loosen, we should always make ready for the next knot. I suppose that the applied mathematician whose theory has just passed one still more stringent test by observation ought not to feel satisfaction, but rather disappointment—"Foiled again! This time I *had* hoped to find a discordance which would throw light on the points where my model could be improved." Perhaps that is a counsel of perfection; I own that I have never felt very keenly a disappointment of this kind.

Our model of Nature should not be like a building—a handsome structure for the populace to admire, until in the course of time some one takes away a corner stone and the edifice comes toppling down. It should be like an engine with movable parts. We need not fix the position of any one lever; that is to be adjusted from time to time as the latest observations indicate. The aim of the theorist is to know the train of wheels which the lever sets in motion—that binding of the parts which is the soul of the engine.

In ancient days two aviators procured to themselves wings. Dædalus flew safely through the middle air across the sea, and was duly honored on his landing. Young Icarus soared upwards towards the sun till the wax melted which bound hs wings, and his flight ended in fiasco. In weighing their achievements perhaps there is something to be said for Icarus. The classic authorities tell us that he was only " doing a stunt," but I prefer to think of him as the man who

certainly brought to light a constructional defect in the flying machines of his day. So too in science. Cautious Dædalus will apply his theories where he feels most confident they will safely go; but by his excess of caution their hidden weakness can not be brought to light. Icarus will strain his theories to the breaking-point till the weak joints gape. For a spectacular stunt? Perhaps partly; he is often very human. But if he is not yet destined to reach the sun and solve for all time the riddle of its constitution, yet he may hope to learn from his journey some hints to build a better machine.

A. S. Eddington

THE HAWAIIAN OLONA

In Science (N. S. 48: 236–38, September 6, 1918) was published a paper by the writer, entitled "The Olona, Hawaii's Unexcelled Fiber Plant." This was later reprinted by the *Literary Digest*, and evidently aroused widespread interest concerning this remarkable fiber. The writer received letters from many parts of the world, requesting further information. Since his previous account he has been furnished with the following statement, by Dr. N. Russel, of Olaa, Hawaii, and originally published in the report of the Hawaii Agricultural Experiment Station for 1902. As this report is out-of-print and unavailable to most students, Russel's excellent account is presented herewith:

Some fifty years ago about 1,000 natives were living on the margin of the virgin forest and pahoe-hoe rock along the trail connecting Hilo town with the crater of Kilauea, island of Hawaii, in a spot corresponding to the present 22-mile point of the volcano road. Making of "kapa" (native cloth) out of "mamake" bark (*Pipturus albidus*), of olona fiber for fishing nets out of *Touchardia latifolia*, and capturing "O-U" birds for the sake of the few precious yellow feathers under the wings, of which luxurious royal garments were manufactured—those were the industries on which they lived.

For the reasons common to all the native population of the islands, viz., the introduction of new germs of disease—syphilis, leprosy, tuberculosis, smallpox, etc.—this settlement gradually dwindled away, and in 1862 the few surviving members migrated to other localities. At present only patches of wild bananas, taro, and heaps of stones scattered in the forest indicate the places of former habitation and industry. I have heard, however, that as late as the seventies Kalakaua still levied a tax in olona fiber from the natives of Puna and Olaa districts, which fiber he sold at high prices to Swiss Alpine clubs, who valued it for its light weight and great strength.

Touchardia grows abundantly in Olaa forests, presenting a kind of a natural plantation. It very successfully holds its own in competition with ferns and other elements of the undergrowth in the shade of "ohia" trees (*Metrosideros polymorpha*). The deep shade, very porous soil, considerable moisture, with a yearly rainfall of 180 inches pretty evenly distributed, are the natural conditions. By removing some of the undergrowth, scattering seed, and probably by planting cuttings, the number of plants on the same area could be greatly increased with but very small expense. Since plants of medium age (about 18 months old) supply the best fiber, natives in gathering used to turn down the older ones with the foot, laying the whole plant on the ground to force new shoots and sprouts.

I was familiar with the plant and its properties for years, but did not pay any further attention to it as a possible object of industry for the reason that to all appearances the same difficulties in mechanical extraction of fiber will be met as in the case of ramie, for which no satisfactory machine has been found. Recently my interest in the matter was again aroused by Mr. Jared G. Smith, of the Hawaii Experiment Station. Considering that *Touchardia* seems to be free from resinous matter, upon his suggestion I decided to examine the subject more in detail. For this purpose an old native, born and raised in the settlement above mentioned, was interviewed. Together with him I proceeded into the forest along twenty-two miles side trail. In my presence

he picked the plants, stripped them of the bark, and with his own olden tools manufactured the sample of fiber.

My object was to ascertain what kind of plants he selects, and to see the primitive method of manufacture, with the idea that this method might furnish some suggestions for the construction of the machine. We had hardly made a dozen steps in the woods along the twenty-two-mile trail when a rich harvest of *Touchardia* was found. We found both male and female plants that could be distinguished only by inflorescence. Whereas male flowers are situated on relatively strong, repeadedly forking cymes, growing out of the base of the leaves, female ones look like so many flattened lumps of green dough planted at the base of the top branches. Both plants are taken indiscriminately. Careful discrimination is made, however, in regard to the age of the plant; neither too young nor too old ones are taken. The bark of the old ones is somewhat knotty, woody, and short jointed, and, as I have mentioned, such plant is turned down to the ground to force it to give new shoots. The best stems are not thicker than the finger, about one year and a half old, with the bark of a chocolate-brown color, with distanced scars of former leaves, straight and high (8 to 10 feet), devoid of leaves except on the top. Such stems are cut with the knife near the root and below the crown. Their bark strips easily as a whole from bottom to the top. The ribbon obtained is hung over the neck of the gatherers. There is also a plant with the leaves very much like those of *Touchardia*, the "hopue"; but this one generally grows to a large-sized tree, has different flower, and light-grayish color of the bark. Neither previous soaking nor drying are resorted to before the extraction. The bark is used raw.

The implements used are: (1) A wood board made of "naou" tree, characterized by its dark color, hardness, compactness, evenness, and absence of knots. This board is about 6 feet long by 2 to 3 inches wide. It has a very light curve in both directions—in width and length; is wider at one end and obtusely pointed at the other. (2) A plate of fish bone of "honu" fish, about 8 inches long by 2½ wide, and is also slightly curved in both directions. Its lower margin is sharpened under 45° like the edge of a chisel.

The process of manufacturing is as follows: The "naou" board is fastened on the ground with rocks at the narrow end to prevent any forward sliding, the curved surface uppermost. The broader end is a little elevated by another piece of rock. The board is moistened with water. A ribbon of bark from one plant is taken. Its bottom end is first fastened by treading on it with the toe of the right foot, the top end raised vertically by the left hand, so as to tightly stretch the band. Holding the fish plate by the right hand in its middle, the sharp end of the bone is passed upward along the inner surface of the ribbon, which operation is intended for flattening the curled ribbon and taking off the slimy substance covering the inner surface. Then the ribbon is stretched horizontally upon the naou board, the bottom end toward the wider end of the board and the operator, and held tightly to it by the two fingers of the left hand, the outer surface of the bark upward, the inner sticking to the board. Then the fish plate, held in the right hand by the middle at 45°, with its sharp end downward and forward, squeezing the ribbon between the tool and the board, is repeatedly passed toward the pointed end of the board, by which motion the flesh is scrapped off, leaving a ribbon of fiber. From one to two minutes are required to free the bark of one plant. The operation of scraping is easy, the fiber evidently being located on the inner surface. The fiber thus obtained is dried in the sun.

Besides manufacturing fishing nets, natives used to make of it the best of their fishing lines. I am told that whalers in former times paid high prices for olona for making lines for whales. There is an old native in Hilo who still uses the line that was made and used by his grandfather.

VAUGHAN MACCAUGHEY

COLLEGE OF HAWAII,
HONOLULU

FRANK SLATER DAGGETT

Under the directorship of Frank S. Daggett, the Museum of History, Science and Art of Los Angeles, has come to exert an important influence in science and education in Southern California. The collections representing the history of California and the southwest, and especially the splendid representation of the extinct life of California secured from the asphalt deposits of Rancho La Brea, have made the institution the object of frequent visits by large numbers of residents of California and by travellers from the east. The rapid development of the museum, the excellent organization of its collections, and the maintenance of a high standard of efficiency throughout the institution were in a very large measure due to the untiring effort of Mr. Daggett. Interesting and valuable exhibits representing living birds, mammals, and molluscs of Southern California were assembled under Mr. Daggett's direction, but by far the most important collection was that representing the extinct fauna secured in the extraordinary asphalt deposits at Rancho La Brea on the western border of the city.

Born at Norwalk, Ohio, in January 30, 1855, Mr. Daggett was for the greater part of his life engaged in commercial pursuits. He was a successful grain merchant at Duluth, Minnesota, from 1885 to 1894, and was a member of the Board of Trade of Chicago from 1904 to 1911. He was always deeply interested in natural history and from his early boyhood was engaged in the study of insects and birds.

His collection of Coleoptera numbered two thousand species and his bird collections contained over eight thousand specimens. Although he published little of a technical nature his interest in natural history subjects was a continued inspiration to many who were professionally engaged in scientific pursuits, and his influence in the advance of natural history of the Pacific Coast has been a factor of much importance.

Mr. Daggett became the director of the Museum of History, Science and Art in 1911. At the time of his assuming the office, the building was finished, but contained no exhibits and no staff appointments had been made. Among the first tasks taken up was the securing of privileges for collecting in the Pleistocene deposits at Rancho La Brea. The excavations were carried on with the most extreme care and with all advice that could be obtained from those especially interested in the scientific study of the deposits. With the utmost precautions the great series of specimens unearthed was cleaned, prepared for study, and marked as to location in the beds. At no stage in the handling of this great collection was anything omitted which might have helped to make the material more useful to the student of future years. Along with its many other contributions to science the Rancho La Brea collection of the Museum of History, Science and Art must always remain as a monument to the scientific interest and administrative skill of Mr. Daggett.

It was the writer's privilege to make the acquaintance of Mr. Daggett at the time of his first interest in the deposits at Rancho La Brea, and to cooperate with him through the whole work of the excavation and preparation of these collections. In these years of close cooperation and friendship he proved himself a man of the highest ideals and finest purposes in development of all that is most fundamental and significant in the phases of natural science with which he came in contact. Although Mr. Daggett's name will not be known in future years by length of publication lists or by species described, there must be given to him a full measure for very significant constructive work done with much interest, with keen insight, and with an effectiveness which is rarely equalled.

John C. Merriam

JOHN LOSSEN PRICER

John Lossen Pricer,[1] of the Illinois State Normal University at Normal, Illinois, died suddenly of heart trouble on August 19, 1920. By his death the scientific interests of Illinois and other mid-western states have suffered a

[1] Born January 10, 1871. A.B. and A.M., University of Illinois, 1907.

very real loss. Professor Pricer had for years maintained an intimate and influential relationship to the problems involved in the teaching of the natural sciences in the secondary schools. His wholesome and extensive personal contact with science teachers and his untiring labor in the work of various educational organizations had brought him into prominence as one of the leaders in the program of reconstruction of the science curriculum of the secondary schools of the middle west. Unusual thoroughness of analysis, fairness of judgment, and whole-hearted sincerity had created for him a place in the esteem of his coworkers in natural science.

As secretary of the Illinois State Academy of Science for a period of four years, his service to that organization has been very marked. In this capacity as well as in his other relations he has done much to bring before the public the needs for more extensive education in science as a foundation for rational living and as an aid to the advancement of public health work.

The reception accorded his work upon the Life History of the Carpenter Ant[2] indicates his ability in original investigation. Teaching duties and a sense of personal obligation to devote his energies to teaching problems marked for him a course that lay chiefly through the educational field though he never lost interest in following the progress of current investigations.

H. J. VAN CLEAVE

SCIENTIFIC EVENTS

THE ERUPTION OF KATLA IN ICELAND

THE volcano of Katla, situated some 50 kilometers southwest of Hekla, was in violent eruption in October, 1918, after remaining quiescent since the last previous eruption in 1860. A note by M. A. Lacroix in the *Comptes Rendus* of the Paris Academy of Sciences, abstracted in the *Geographical Journal*, gives some account of the eruption from data sent to him from Iceland. A little after noon on the 12th a slight earthquake shock was followed by the uprising above the Mýrdalsjökull of an enormous column of incandescent ashes visible throughout the island for 200 to 300 kilometers. At Reykjavik a thick fall of ash darkened the whole sky, and a tidal wave was experienced on the coast south of the volcano. As is usual in Iceland, the paroxysm was accompanied by violent glacier outbursts. The first visitor to the crater after the eruption was M. Pall Sveinsson, whose notes have been placed at M. Lacroix's disposal. Katla lies in the east-southeast of the Mýrdalsjökull, one of the great ice-masses of southern Iceland, and on its southeast side extends the Mýrdalsandur, a great desert of sand formed of the material deposited during the glacial outbursts. In the northwest and southwest the Mýrdalsjökull is surmounted by two domes of ice rising to heights of 1,500 to 1,600 meters. Between them is a cup-shaped depression at the bottom of which the crater of Katla opens. Even the outer slopes of the ice-dome by which M. Sveinsson ascended were covered with ashes to a depth of half a meter, and those falling to the crater with half as much again. The rift of the crater, which measured from 500 to 800 by 40 meters, was free from ice, but water was flowing along it. No fumeroles nor products of sublimation were seen, only a yellowish-brown mud, the lighter portions of which seem derived by alteration from the darker, heavier ash. The glacier torrents had opened two deep ravines towards the south and east, and had done considerable damage, carrying with them huge masses of ice to a distance of 30 kilometers. The stony débris had formed a vast promontory on the coast similar to that formed in 1860. Like the thirteen previously recorded eruptions, that of 1918 was exclusively explosive, with no outpouring of lava—a fact more remarkable from the vicinity of Katla to the scene of the great fissure eruption of 1783. A chemical comparison of the ash of 1918 with the lava of 1783 will be of interest, for it is possible that the exclusive explosive character of the Katla eruptions may be due to the superimposition of the enormous ice-mass of the Mýrdalsjökull. A preliminary

[2] *Biological Bulletin*, Vol. 14 (1908).

analysis of the ash shows it to be rich in titanium, a character common to the few examples yet analyzed of the basaltic volcanic rocks of Iceland, the Færoes, and Greenland.

UTILIZATION OF THE FORESTS OF ALASKA

COLONEL W. B. GREELEY, the new chief forester of the United States, has returned from a month's inspection of the timber, water power and national resources of Alaska. In an interview in the Seattle *Post-Intelligencer* he is reported to have said:

Alaska has more than 100,000,000 cords of pulp wood. The territory has sufficient timber resources to produce 1,500,000 tons of paper annually. The Alaska Pulp and Paper Company, comprising California interests, is now constructing the first pulp plant at Port Snettisham, in southeastern Alaska. This mill will be supplied with 100,000,000 feet of timber just purchased from the Forest Service and is probably the forerunner of a large pulp and newspaper factory at that point.

In addition to the vast pulp resources of Alaska, Puget Sound offers splendid opportunity for at least six large pulp and paper mills. There are frequent inquiries of the Federal Forest Department for pulp wood concessions in this state. Even at the present time there is enough or would be enough wood of inferior quality cut in logging camps to support a large local paper industry here.

Establishment of such an industry on Puget Sound would be a great accomplishment from the standpoint of practical conservation—it would afford a market for inferior woods now being wasted in logging camps already established. In addition, there are large areas of hemlock and spruce and balsam on the Olympic Peninsula and in the Snoqualmie national forest. The entire forestry industry of the United States is moving westward, and with it is coming the paper industry.

Alaska contains 100,000,000 cords of pulpwood. She has the resources to produce 1,500,000 tons of paper yearly. That is nearly a third of the paper used in the United States, an amount nearly equal to what we are now compelled to import from Canada. With reasonable care, under the methods followed by the Forest Service, this output can be kept up from the national forests of Alaska perpetually. There is a real solution of the paper shortage.

A few years ago we heard much about the inferior character of the forests in Alaska. As a matter of fact, aside from enormous quantities of good pulpwood and serviceable construction timber, the territory probably contains the largest quantity of clear, high-grade spruce to be found in the United States.

During the war this spruce passed every test for airplane construction, and it is now being shipped to the eastern states in increasing quantities for car and factory stock and high-grade finish. One of the things we shall accomplish by bringing the paper industry into Alaska will be to open up her thousands of miles of coastal forests and make available a much larger supply of special products like cedar, clear spruce and long piling.

THE INTERNATIONAL CHEMICAL CONFERENCE

THE third session of the International Chemical Conference met at Rome, June 21 to 25, with Professor Charles Moureu, member of the Institute of France, as president. According to the account of the *Journal of Industrial and Engineering Chemistry* the program began with the meeting of the council of the International Union of Pure and Applied Chemistry, composed of the representatives of the five nations which founded the Union. The council considered the adhesion to the union of seven new countries: namely, Canada, Denmark, Spain, Greece, the Netherlands, Portugal and Czecho-Slovakia, which were all admitted. The plan of organization and administration of the International Union of Pure and Applied Chemistry, which was presented by M. Gerard, was as follows:

To adhere to the union a country must establish a liaison between its chemical groups by the formation of a national council or federation. The initiative of this organization must be taken by a chemical society, the National Academy, the National Research Council or a similar national institution, or by the government.

The union is governed by the council, composed of delegates from each of the supporting countries, whose executive power is vested in a bureau. The general assembly receives reports from the council, approves the accounts of the past session, adopts the budget for the following session, and considers the questions to be included on the program. Under the council and an executive com-

mittee, a permanent staff carries out the program of action as defined by the bureau. This staff is situated at the headquarters of the union, and is the pivot of all the organizations connected therewith. The council can also establish permanent committees as they may seem necessary.

An advisory committee, divided into sections corresponding to the different scientific and industrial branches, considers in detail the questions figuring in the program of action. The associated nations are represented in each section by delegates, elected for three years. The delegates of each nation constitute a national committee, whose duties include the study of questions interesting to chemistry from scientific, industrial, and economic points of view.

A meeting of the council, of the permanent committees, of the advisory committee, and of the General Assembly is held each year, under the title of the "International Chemical Conference."

The report presented by Professor Lindet, for the Fédération Nationale des Associations de Chimie de France, asking that the International Congress be joined to the union, provides that the International Conference shall every four years be converted into an International Congress of Pure and Applied Chemistry. Elections to the council, to permanent committees, and to the advisory committee shall take place at this time.

The languages for the congress are English, French and Italian. Communications may be made in another language, provided authors give a translation or an abstract in the official languages. To avoid errors in interpretation, communications, votes, resolutions, and official acts, if not originally offered in French, must be translated into that tongue.

To encourage research, the council may, within the limit of funds granted each year by the assembly, award prizes and medals to the authors of work considered worthy of such distinction.

MISSOURI EXPERIMENT STATION OF THE BUREAU OF MINES

SECRETARY OF THE INTERIOR PAYNE, acting on the recommendations of Dr. F. G. Cottrell, director of the Bureau of Mines, has selected Rolla, Mo., as the place for the latest mining experiment station of the bureau. This station will look after the mining interests of the Mississippi Valley and will give consideration to the various problems which are met with in the production of lead and zinc.

After a careful investigation, The Missouri School of Mines and Metallurgy at Rolla, Mo., was selected as an ideal place to carry on much of the actual laboratory and investigative work of the new station. However, it was also decided that the central offices of the station should be at or near St. Louis, Missouri. Consequently, the plan is that the actual laboratory and investigative work shall be done in cooperation with the Missouri School of Mines and Metallurgy at Rolla, but that headquarters of the station should be in St. Louis.

For a long time the Bureau of Mines has desired to take up, in cooperation with the mining and metallurgical industry, those problems met with in the Mississippi Valley where lead and zinc deposits occur. As is well known, the ores of this district are for the most part sulphide ores and are ordinarily not difficult to treat. However, there are also large deposits of oxidized lead ores in certain districts of Missouri, and their mining and metallurgical treatment presents a serious problem. Concentration by gravity methods had been tried for years on these ores, and there are many thousands of tons of high grade tailings, as well as crude ore, awaiting proper methods of recovering metallic values. Such being the case, the bureau will carry on such research and investigational work in connection with the treatment of these ores as will assist in the development of processes which will prevent their being wasted, due to the lack of a metallurgical process which it may be commercially feasible to apply to them.

SCIENTIFIC NOTES AND NEWS

PROFESSOR R. ROUX, director of the Pasteur Institute at Paris, has been awarded by the United States government the Distinguished Service Medal for especially meritorious and distinguished service which was of great consequence to the American Expeditionary Forces.

A PRESENTATION from more than two hundred subscribers has been made to Dr. W. L. H. Duckworth, fellow of Jesus College and senior demonstrator in anatomy, in the Uni-

versity of Cambridge, on the completion of twenty-one years of service to the university as lecturer in physical anthropology.

DR. NOEL BARDSWELL, medical adviser to the London Insurance Committee, has been awarded the Médaille de la Reconnaissance Française for services rendered in Paris in connection with the treatment of the tuberculous French soldier and the establishment of an agricultural training colony at Epinay.

THE Dr. Jessie Macgregor prize of the Royal College of Physicians, Edinburgh, has been awarded to Miss Lucy Davis Cripps for her work on tetryl.

A DINNER was given July 26 by the president, vice-president and governors of the American Hospital in London to Dr. Charles H. Mayo, of Rochester, Minn.

H. L. HARNED has been appointed consulting chemist and R. L. Sebastian, research industrial chemist, to the Pennsylvania State Department of Health Laboratories.

DR. W. C. PHALEN, formerly geologist in the U. S. Geological Survey and mining technologist in the Bureau of Mines, has been engaged as geologist by the Solvay Process Co., with headquarters at Syracuse, N. Y.

MR. LEWIS DAVIS, formerly biological chemist in the research laboratory of Parke, Davis & Company, Detroit, Mich., is now associated with the Beebe Laboratories, Inc., St. Paul, Minn., as associate laboratory director.

O. B. WHIPPLE, professor of horticulture in Montana College has resigned to engage in farming in Colorado.

LIEUTENANT COLONEL HARRY PLOTZ, M.C., U. S. Army, has returned from Europe after spending several months in investigating the spread of typhus fever in infested regions. Typhus fever is raging in Poland, Southern Russia and Eastern Europe.

DR. LIVINGSTON FARRAND, chairman of the American Red Cross, formerly president of the University of Colorado and professor of anthropology in Columbia University, has gone to Europe.

THE Ramsay Memorial Executive Committee has decided to close the general fund. The total amount received up to date is £53,402, this sum being exclusive of the fellowships founded by the Dominion and foreign governments, the capital value of which is estimated at about £30,000. Although the general fund is closed, contributions sent in to the treasurers, Lord Glenconner and Professor J. Norman Collie, at University College, London, can still be included in the complete list of subscriptions which is now being prepared. The Ramsay Memorial Fellowship trustees have elected Mr. William Davies, M.Sc. (Manchester), at present working in the chemistry laboratories of the University of Oxford, to a Ramsay Memorial Fellowship. This election is the first election to a fellowship provided from the Ramsay general fund.

IT is proposed to establish in Panama an international institute for research on tropical diseases as a memorial to the late Major-General William C. Gorgas. Panama has been chosen in view of the fact that General Gorgas' most noteworthy work was accomplished there.

JAMES WILSON, secretary of agriculture in the cabinets of Presidents McKinley, Roosevent and Taft, previously professor of agriculture in the Iowa State College and director of the Experiment Station, died on August 26, at the age of eighty-five years.

BENJAMIN SMITH LYMAN, geologist and mining engineer of Philadelphia, died on August 30, in his eighty-fifth year. Mr. Lyman, who graduated from Harvard in 1855, had traveled extensively in the United States, British America, Europe, India, China, Japan and the Philippines in connection with his geological researches. In 1870 he was employed by the Public Works Department of India, surveying oil fields. From 1873 to 1879 he was chief geologist and mining engineer for the Japanese government. From 1887 to 1895 he was assistant geologist of the state of Pennsylvania.

WILHELM WUNDT, professor of philosophy at the University of Leipzig, where he established the first laboratory of psychology, died on August 31, in his eighty-ninth year.

ADAM POLITZER, professor of otology at Vienna, has died at the age of eighty-six years.

Nature states that one of the first official acts of the new high commissioner of Palestine has been the establishment of a Department of Antiquities. An international board will advise the director on technical matters. Provision is made for an inspector, for a museum, and for the custody of the historical monuments. The museum starts with more than 100 cases of antiquities collected by the Palestine Exploration Fund and other bodies before the war. On August 9 the new British School of Archeology was formally opened at Jerusalem by Sir Herbert Samuel.

THE Pennsylvania State College has received from the Rockefeller Institute for Medical Research a grant of $5,000 for the current fiscal year in aid of the researches in animal nutrition which have been carried on for the past twenty years by the Institute of Animal Nutrition under the direction of Dr. H. P. Armsby.

THE autumn meeting of the British Institute of Metals will be held at Barrow-Furness on September 15 and 16, under the presidency of Sir George Goodwin.

IN the second week of September there is to be a gathering at the School of Anthropology at Paris of a number of persons interested in forming an International Anthropological Institute and in making it the center for the anthropologic sciences, including ethnology, eugenics, medical geography, comparative anatomy, etc.

THERE has been organized the Mexican Society of Biology which for the time being will hold its meetings at the headquarters of the National Academy of Medicine. The officers of the association are: *President,* Dr. D. Fernando Ocaranza; *Treasurer,* Dr. Eliseo Ramírez, and *Secretary,* Dr. Isaac Ocheterena. The society has ten charter members, practically all physicians. The address is Av. del Brasil, No. 33, Mexico.

THE chief executive officers and large stockholders of the General Chemical Company, the Solvay Process Company, the Sement-Solvay Company, the Barrett Company and the National Aniline & Chemical Company, have approved a general plan for submission to the respective boards, for the consolidation of the five companies.

WE learn from *Nature* that at the council meeting of the National Association of Industrial Chemists, held at Sheffield on August 7, the secretary reported that a number of firms had given a definite undertaking to consult the officials of the association in all matters relating to chemists, their appointment, salaries, and conditions of employment. The salaries paid to members of the association were fairly satisfactory; in this connection a report has been issued giving a schedule of minimum salaries, and this would be circulated shortly. The secretary stated that the number of unemployed chemists was increasing rapidly, and there was every indication of a coming great slump in the engineering and allied industries in which their members were employed. It was more than ever imperative for industrial chemists to unite to preserve their interests. Mr. A. B. Searle (Sheffield) was unanimously elected president for the coming year, and Mr. J. W. Merchant appointed secretary. The appointment of an organizing secretary for propaganda work was authorized.

UNIVERSITY AND EDUCATIONAL NEWS

BY the will of the late William K. Vanderbilt, Vanderbilt University receives $250,000.

BY the will of the late Miss Annette P. Rogers, daughter of the first president of Massachusetts Institute of Technology, Radcliffe College receives $175,000.

Two research fellowships of $1,200 each have been established at Rutgers College by Dr. J. G. Lipman, dean of agriculture and director of the experiment station at that institution. The appointees to the fellowships will study problems relating to the place and functions of sulfur in the plant world.

DR. CALVIN C. APPLEWHITE, U. S. Public Health Service, has been detailed to establish

a school of public health and hygiene in the medical department of the University of Georgia, Augusta.

Dr. Arthur S. Hathaway, since 1891 professor of mathematics at the Rose Polytechnic Institute, has retired from active service. He is succeeded by Dr. I. P. Sousley, of Pennsylvania State College.

Professor Frederick Slocum has returned to Wesleyan University as professor of astronomy and director of the Van Vleck Observatory.

Mr. Guy R. McDole, assistant soils chemist in the Minnesota Agricultural Experiment Station, has accepted a position as associate professor of agronomy and soil technologist at the University of Idaho.

Dr. Robert Stewart, who has for the past five years been associated with the late Dr. Cyril G. Hopkins at the University of Illinois as professor of soil fertility, has resigned his position to accept the deanship of the college of agriculture of the University of Nevada.

Dr. Arthur T. Evans has accepted the position as associate agronomist in South Dakota State College and Experiment Station. He has previously been professor of botany and dean at Huron College; and earlier engaged in corn disease investigations with the Cereal Office of the United States Department of Agriculture.

Dr. Wm. Conger Morgan has resigned his position as professor of chemistry at Reed College to become professor of chemistry at the Southern Branch of the University of California at Los Angeles.

C. Lee Shilliday, professor of anatomy and histology in the college of dentistry, University of Tennessee, has accepted the professorship of biology in the Pennsylvania College of Gettysburg, to succeed Dr. George Stahley, who has retired after thirty years' service.

Associate Professor Burt P. Kirkland, and Assistant Professor E. T. Clark, of the college of forestry and lumbering of the University of Washington, have been promoted, the former to a full professorship and the latter to an associate professorship.

Dr. William Boyd, professor of pathology in the University of Manitoba, Winnipeg, has declined the offer of the chair of pathology at the medical school, Cairo, Egypt.

Dr. Friedmann, the value of whose turtle vaccine for tuberculosis is questioned, has been appointed extraordinary professor at the University of Berlin against the vote of the medical faculty.

Dr. A. Gosset, professor of external pathology of the Paris medical faculty, has been appointed to the chair of clinical surgery left vacant by the retirement of Professor Quénu, and Dr. Vaquez, professor of internal pathology, has been appointed to succeed Professor Robin in the chair of clinical therapeutics.

DISCUSSION AND CORRESPONDENCE

A BAND SPECTRUM FROM MERCURY VAPOR

To the Editor of Science: The writer has recently observed that under certain conditions the discharge through mercury vapor gives a glow that is distinctly green. An examination of this glow shows the ordinary line spectrum of mercury together with a spectrum which is apparently continuous through nearly all of the visible spectrum, being most prominent in the green. So far as the writer has been able to learn there is no record of such a spectrum having been obtained from the discharge through mercury vapor.

Two conditions are necessary for obtaining this spectrum with any considerable brightness. First the vapor through which the discharge takes place must be passing from a hotter to a colder region, as from the mercury arc or from the mercury heated by a flame to a condensing chamber, that is, through vapor that is condensing.

Secondly the voltage must be kept as low as possible and yet have a discharge. As the voltage is raised the ordinary line spectrum becomes more prominent and the continuous spectrum less so. The discharge from a Wimhurst machine or from a transformer shows the glow somewhat better than that from an induction coil. Putting condensers in parallel

with the spark has the same effect as increasing the current. It is possible to obtain the glow from hot calcium oxide providing the discharge is kept very small.

The shape and position of the electrodes have no appreciable influence on the production of this glow. It is produced equally well from platinum and from iron electrodes and in tubes made from soda and from lead glass. It does not appear to depend on the purity of the mercury.

It requires approximately .001 sec. for the glow to die out after the exciting current has ceased. As a result of this continuance of the glow the radiators may continue to give light while being carried with the current of mercury vapor for 20 or 30 cm.

These radiators do not appear to be charged. Thus if the luminous vapor containing them is passed through wire gauze, no effect is produced on the intensity of the continuous spectrum when the gauze is charged negatively. This is quite different from the behavior of the radiators of the line spectrum which may be entirely removed by this means. It is possible in this way to obtain the continuous spectrum without any of the line spectrum appearing.

As far as has been observed there are no lines or separate bands in the spectrum here described. It is, however, possible that a spectroscope better than the one at the command of the writer may show such lines.

It appears probable that we are here dealing with a vapor which is intermediate between a gas and a liquid. When a gas is condensing there must be a time when two or more atoms have combined to form clusters. Such a vapor might be expected to give a spectrum intermediate between a line spectrum as given by a gas and a continuous spectrum as given by a liquid or solid. This is a fact the kind of spectrum here observed.

Further work is being done on the subject and it is expected that the results will soon be published in more complete form.

C. D. CHILD

COLGATE UNIVERSITY,
August 6, 1920

A NEW VARIETY OF THE ROOF RAT

DURING the second week of March of this year Miss Jane F. Hill, one of our students, brought to the laboratory about a dozen rats, which had been taken on her father's farm. The farm is located fifteen miles from Austin, in Travis County, Texas. Seven of these rats were cinnamon in color, the others, obviously the wild type, were gray or brownish. The cinnamon color is restricted to the back and sides of the head and body, and is due to the presence of yellow pigment in the outer ends of the hairs, the pigment of the hair base probably being chocolate. In the type and mutant specimens the fur on the ventral surface, from the chin to the base of the tail, is snow white, the hairs being white from the tip to the base.

We attempted to keep these rats in the laboratory, but after a few weeks they began to die. I then instructed one of our assistants to preserve the skins. Some of these were later sent to Professor W. E. Castle, who showed them to Dr. G. M. Allen. Dr. Allen identifies the species as the roof rat, *Mus alexandrinus*.

We were anxious to establish a stock of the cinnamon rat for genetic studies, and through the kindness of Miss Hill and her family, I was able to visit the farm on July 6. During the day we captured 215 rats. Upon examination, the rats proved to be of three varieties, *Mus norvegicus, Mus alexandrinus,* and the cinnamon mutant. We took 61 specimens of the common Norway, 138 of the type of roof rat, and 16 of the cinnamon. Undoubtedly some of the 138 specimens of the roof rat are heterozygotes. We were fortunate enough to capture a mother and four young in one nest. Three of the litter are like the brownish-gray mother, and the third a typical cinnamon.

The interesting point concerning the discovery of this cinnamon rat relates to its origin. When and how did it happen to appear on the Hill farm? With a view of answering these questions, I made a careful study of the conditions on the farm. The farm buildings where the rats are found are close together and

are fairly well isolated. With the exception of one neighboring place, located about 400 yards from the Hill buildings, all other neighbors are at least a half mile distant. The cinnamon rats had not been observed prior to last Christmas, when Miss Hill saw a single animal in the grain house. From time to time others were seen in increasing numbers about the place.

The rats in the farm buildings have reached such numbers that they have become very destructive. This coupled with the fact that bubonic plague has appeared in Texas, made it necessary to attempt their extermination. During the past few weeks over 1,000 rats have been killed, and among these were found a number of the cinnamon variety. From the best available data, I estimate that at present the proportion of cinnamon specimens to all others is about 15 to 200.

The cinnamon rat has not been observed at any of the neighboring places, with the exception of the one located 400 yards away, where two animals were recently seen. All of the evidence points to the conclusion that this new variety arose, possibly as a mutation from *Mus alexandrinus*, on the Hill farm some time during the latter part of last year.

This rat should furnish an opportunity for some interesting genetic studies. In a recent letter Professor Castle has called attention to the value of this material. He says:

> This would be very interesting genetic material for there is known to be a yellow variety of the roof rat, in addition to the black variety (*Mus rattus*), and if this cinnamon variety can be added to the number (with albinism, which I presume must exist among roof rats), it would be possible to work out from this material a parallel series to that which occurs in the Norway rat, possibly even a more complex series, and it would be of interest to know whether the linkage relations are the same in the two species.

J. T. Patterson

Austin, Texas,
July 22, 1920

ANOTHER CORN SEED PARASITE

A fungus which seems to have had very little consideration as a parasite has recently been isolated from sweet corn seed by the writers while making a study of the internal parasites of some agricultural seeds.

This fungus was frequently found in corn from a field that last year had many dwarf and distorted stalks and some barren stalks and root rot. Seeds of this corn were examined for internal parasites by treating three minutes with corosive sublimate solution according to a method which the authors have worked out and found to be very satisfactory. After this external disinfection they were planted in sterile tubes of nutrient solution on cotton. In about a week a white fungus had grown out from many of the seeds, some of which had also germinated. The roots of the seedlings were attacked by the fungus and died in about two weeks. Healthy seedlings in sterile tubes were inoculated and died in five to nine days.

The pathogenicity of the fungus was further tested under more normal conditions on corn grown in pots in the greenhouse, by pouring a suspension of the spores from pure cultures around the roots and by punctures with an infected needle just above the ground. Several of the plants so infected showed the dwarfness and distortion seen in the field the previous year. Those inoculated by puncture made 19 per cent. less growth in height than the controls and the soil inoculations made 13 per cent. less. Fungous mycelium was found in the discolored tissue at the base of the stem of these infected plants and the original fungus was obtained in cultures from this diseased tissue.

This fungus corresponds very well, so far as one of its methods of spore formation is concerned, with descriptions and figures of *Oospora verticilloides* Sacc., found on corn in Italy by Saccardo in 1877. It was extensively studied by Tiraboschi[1] in an investigation of organisms in corn that might be connected with pellagra. Tiraboschi, like practically all other students of corn diseases, apparently overlooked similar work done in Russia in 1895 and 1896 by Deckenbach, who in addi-

[1] *Annali di Botanici*, 1905.

tion found that *Oospora verticilloides* was parasitic on corn. Deckenbach's work was published in Russian journals from 1896 to 1899, and after Tiraboschi's paper was published, Deckenbach reviewed his original work in *Centr. Bakt.*, 1 Abt. Originale, 45:507–512. 1907.

It is probable that this fungus has been recorded under other generic names by some writers. *Cephalosporium sacchari*, described by Butler as a sugar cane parasite in India, accords very well with our fungus, except that the conidia in chains were not noted by him. The distinctions between *Cephalosporium*, *Acrostalagmus*, *Verticillium* and similar genera are slight, and as the chains of spores of our fungus are not always easily found, this corn parasite may sometimes have been classed in one of these genera. The writers find, however, that the conidia are produced in two different ways: at first they are aggregated in small droplets at the ends of the short, sometimes verticillate, lateral branches of the erect fertile hyphæ, and later produced in long chains on the ends of the upper branches. In older cultures septate spores are occasionally found and if a *Fusarium* stage should develop our fungus would have to be referred to Sheldon's *Fusarium moniliforme* which would then better be called *Fusarium verticilloides*.

J. B. S. NORTON,
C. C. CHEN
MARYLAND AGRICULTURAL EXPERIMENT STATION

SCIENTIFIC BOOKS

Orthoptera of Northeastern America with Special Reference to the Faunas of Indiana and Florida. By W. S. BLATCHLEY. May, 1920. Indianapolis: The Nature Publishing Co.; 8vo, 784 pages, 246 text figures and 7 plates.

This work comprises a very full consideration of the 353 species and 58 varieties of Orthoptera recorded from the region covered, and is the most comprehensive treatise on this group of insects so far published in America. While prepared more especially for the tyro, this volume contains a wealth of assembled information of undoubted value to professional workers. As clearly set forth on pages 5 to 7 of the introduction, this work portrays the individual ideas of the author as to the systematic value of taxonomic characters used in classification. The conclusions reached, while not always in accord with recent usage, appear to be generally sound.

The biology and anatomy of the Orthoptera are treated at some length and the parasites and other enemies of the group are discussed. Economic questions are covered and the collection and preservation of specimens fully treated. The systematic portion includes dichotomous keys to suborders, families, genera and species. The derivation of generic names is given when known and many species are figured. The illustrations are mostly taken from previously published works, but the figures are well selected for the purpose of the present manual. Under each species is a description followed by notes on synonymy, distribution, habits, etc. Citations to literature are made by reference to a chronologically arranged author's bibliography. A glossary of terms used is given and there are two indices, one of synonyms with generic assignment and one of genera and species as here treated.

There is in general little to criticize in this very admirable treatise, though a critical review written by any specialist would probably point out a number of details considered open to special criticism. As is inevitable with a volume of this size a number of typographical and other errors occur. But on the whole it is a carefully prepared work, and one which will be indispensable to all students and collectors of these insects.

A. N. CAUDELL
BUREAU OF ENTOMOLOGY,
U. S. DEPT. OF AGRICULTURE

Manual of the Orthoptera of New England, including Locusts, Grasshoppers, Crickets, and their allies. By ALBERT P. MORSE. April, 1920. *Proc. Bost. Soc. Nat. Hist.*, Vol. XXXV., p. 197–556, text-figures 1–99 and plates X–XXIX.

Bearing a date a month earlier than the above work by Blatchley, but received nearly a month later, comes this volume, a magnificient treatise on the orthopterous insects of New England. An introduction to the literature of New England Orthoptera is given and the anatomy and biology of this group of insects are discussed at some length. The distribution of the species within the region covered is considered and there are several pages devoted to a consideraton of the economic relations of the Order, including discussions of parasites and other enemies. Collecting and preserving are fully treated and there are keys to genera and species and higher groups. Under each family are notes on habits, etc., and under each species are references to the more important literature on the species and its synonyms. There are also notes on occurrence and, usually, brief descriptions. One hundred and thirty-two species are recorded, sixteen of which are considered adventive. There is no bibliography of works cited. The structural details of a large proportion of the forms treated are figured, and many are more fully illustrated, some in colors. There are also a number of reproduced photographs showing certain characteristic habitats of Orthoptera. Three colored plates and a few other illustrations are original, but most of the figures are reproduced from previously published works. An accented list of scientific names, a glossary, and an index conclude this most excellent manual.

A. N. CAUDELL

BUREAU OF ENTOMOLOGY,
U. S. DEPT. OF AGRICULTURE

SPECIAL ARTICLES

A STAND FOR THE BARBOUR MICRODISSECTION APPARATUS

THE following is a description of a stand devised by the writer and Mr. F. H. J. Newton, mechanician at Wesleyan University, for use with the Barbour microdissection apparatus. The dissecting apparatus was also made by Mr. Newton, who reproduced with slight modifications, in part suggested by Dr. Robert Chambers, the two-needle model formerly made in the Fowler shops of the University of Kansas.

The principal advantage of the stand as previously stated by Dr. Chambers[1] is that the dissecting apparatus is attached to a shelf independent of the microscope and consequently the latter may be shifted to various positions with reference to the dissecting apparatus. Also another microscope or binocular microscope may readily be substituted without the necessity of the assistance of a machinist to construct a shelf on each microscope used.

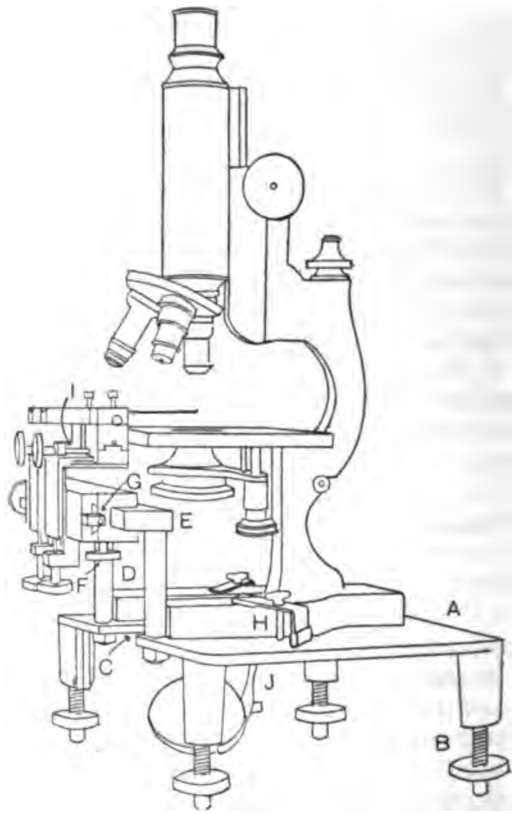


FIG. 1.

The drawing here shown omits for simplicity certain details of the dissecting apparatus as it has been figured elsewhere.[1] The thumb screw on the right side which is at-

[1] Chambers, R., *Biological Bulletin*, Vol. 34, 1918.

tached at G is omitted from the drawing in order to show parts otherwise concealed.

The essential parts are the platform and shelf. The platform, A, which measures 9½ by 7 inches is supported on legs having leveling screws, B, and has a portion cut out, C, on the longer side similar in form to the open space between the sides of the horseshoe base of a microscope. This opening is to admit light from an ordinary microscope mirror suspended beneath the stand by a jointed arm, J, allowing lateral motion and which is in turn attached to a horizontal rod sliding back and forward in a tube on the under surface of the platform. On the front edge of the platform bridging the light opening is the shelf, E, supported by two pillars, D. The dissecting apparatus is clamped to this shelf by the screw, F. The microscope may be firmly secured to the platform by the clamps, H, and holes are drilled in the platform to accommodate various positions of the microscope, but frequently the use of the clamps is unnecessary.

Dr. Chambers has suggested that I call attention to a useful improvement of his own dissecting apparatus introduced by E. A. Thompson, of Amherst, Mass. Fine springs placed around the screws which move the needle carriage as at I in the figure prevent lost motion and thus steady the initial motion of the needle which is a marked advantage in the finer work.

H. B. GOODRICH

WESLEYAN UNIVERSITY

GASTRIC RESPONSE TO FOODS[1]

IX. THE INFLUENCE OF WORRY ON GASTRIC DIGESTION

THE study of the influence of emotional strain on digestion in man offers some difficulties due to the fact that the emotions can not be readily controlled, nor are the subjects of extreme emotion readily amenable to experimentation. We were, however, able to obtain an interesting illustration of the profound effect of mental anxiety on gastric digestion in the case of a first-year medical student who had previously served as a subject of gastric tests and whose stomach had been found entirely normal. This man was given one hundred grams of fried chicken on the morning of an important examination in chemistry, and was asked to write out his answers during the course of the test. He was plainly worried over the outcome of the examination and of his year's work. The resultant effect upon gastric digestion in prolonging evacuation for over two hours, with high intra-gastric acidity is charted in the figure. The same chart gives the normal

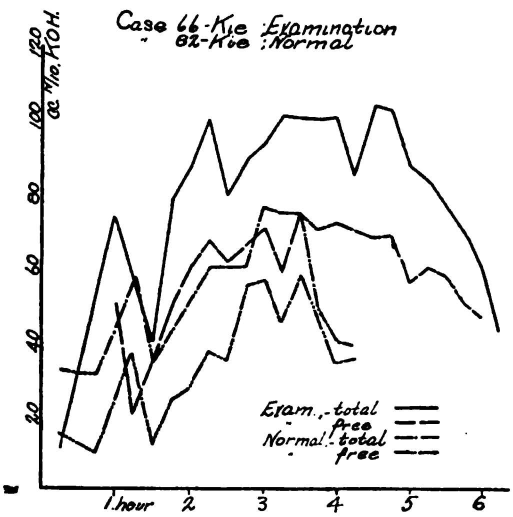


FIG. 1.

digestion curve for fried chicken on this subject as obtained a week later under the best mental conditions.

The experiments were carried out by withdrawing samples from the stomach of the subject with the Rehfuss stomach tube at fifteen-minute intervals until the stomach was empty. The specimens were analyzed for total acidity and free hydrochloric acid and results expressed as c.c. of N/10 alkali required to neutralize 100 c.c. of sample.[2]

[1] The expenses of this investigation were defrayed by funds furnished by Mrs. M. H. Henderson.

[2] Fishback, Smith, Bergeim, Lichtenthaeler, Rehfuss and Hawk, *Am. Jour. Physiol.*, 1919, XLIX., 174, and later communications.

Pavlov, Cannon, Bickel and Sasaki[3] and others have shown that in animals fear and rage may exert a most pronounced inhibiting effect on gastric peristalsis and secretion. It is also known that the clinical symptoms of gastric ulcer may be aggravated by emotional excitement due apparently to delayed evacuation associated with the hypersecretion of gastric juice commonly found in such cases. Our experiment is a clear-cut demonstration of a purely emotional dyspepsia and may serve as an additional emphatic warning to us all not unnecessarily to carry our troubles with us to the dinner table.

Raymond J. Miller,
Olaf Bergeim,
Philip B. Hawk

Jefferson Medical College

THE AMERICAN CHEMICAL SOCIETY. VI

Problems in specifications for reagent chemicals: W. D. Collins. The following suggestions are offered as a basis for discussion: (1) The American Chemical Society should establish and publish specifications for chemical reagents. (2) Strength and purity should be prescribed as high as is consistent with good manufacturing practise. (3) The method of determining strength should be fully described. (4) Only impurities likely to be present should be considered. (5) For nearly all impurities a test should be described which will give no result with a satisfactory chemical. (6) The specifications should contain no provisions for penalties or premiums for variations from the strength and purity prescribed. (7) The specifications should not in general demand the purity required for work of the very highest refinement. (8) Specifications for containers are not necessary. (9) Names of manufacturers or brands should not be used in the specifications.

The standardization of laboratory apparatus and instruments in respect to quality, shape, size and packing: Thomas B. Freas. The manufacture of apparatus in this country is necessary in order to produce enough qualified skilled workers and experts to aid in times of national emergency. The cost of labor being high, the quantity basis of manufacture is urged. The splitting of endeavor is caused by the manufacture of too small quantities of any particular piece of apparatus. Quality, shapes and sizes of glassware, porcelain ware, rubber goods, woodenware, and platinum need standardizing. Possibly the number of shapes and sizes, at least, could be reduced to such an extent that the output per individual article would be materially increased. Reasons for packing in standard packages are also given and it is shown that this will tend to reduce overhead, especially in the dealer's business and allow a consequent reduction to the consumer. It is proposed to have a standardization office with a draftsman, the expenses of this office to be met by a small fee upon all the apparatus bearing the stamp of the committee of this society. If this small fee does not seem feasible, then some scheme should be adopted by which the Bureau of Standards would be able to carry out the ideas of standardization.

Recovery of the grease from the soapy wash waters in laundering: I. N. Kugelmass. On the average a twenty-five gallon first suds waste yielded about one half liter of fatty acids extracted by gravitational separation through naphtha.

A rapid soap dissolving-distributing system: I. Newton Kugelmass. The soap-dissolving tank contains a forty-five degree inclined perforated support suspended near the top of the tank, automatically fed with soap flakes and the whole immersed in water. An electric stirring device hastens solution. The clear soap solution is distributed to washers by pipe lines. At each washer a gauge gives the volume of soap solution passing through it into the washing machine. Advantages: rapid solution, economy in soap, time, and labor, correct soap concentration in washers.

The recovery of iodine from kelp: Merle Randall. This paper is a summary of a study of the leach liquors at the U. S. Kelp-Potash Plant at Summerland, Calif. Green kelp, such as is harvested on the Pacific coast, contains about 0.0016 per cent. of iodine. The kelp is dried in direct heat driers, and chared either in incinerators or in retorts. The char is leached with hot water, and potassium chloride and sodium chloride removed from the leach liquor in crystallizing evaporators. Iodine should remain in the mother liquors. The

[3] Pavlov, "The Work of the Digestive Glands," London, 1902; Bickel and Sasaki, *Deutsch. med. Wochenschr.*, 1905, XXXI., 1289; Cannon, "Bodily Changes in Pain, Hunger, Fear and Rage," New York, 1920.

solutions contain sulfates, carbonates and reducing substances. A method for determining the upper limit, which can be profitably used for the iodide concentration in the mother liquor is discussed. The recovery of the iodine represents not only the saving of a valuable by-product, but makes the operation of the evaporator house simpler, for the reason that the carbonates and a portion of the sulfates are disposed of. The iodine is liberated by means of acid and bleaching powder. The iodine is removed from the solution by means of live steam.

A plan for incentive to research in pure and applied chemistry: W. J. HALE. The latent possibility of the university assistantship is depicted and the ideal fellowship for the university defined. The so-called industrial fellowships for industrial ends are severely criticized. Several basic premises are drawn up and these lead directly to the conclusions that university researches should be concerned primarily with pure chemistry and not with industrial problems, else, chemical progress now so much more marked outside the academic walls will still further outrank the advancement made at our universities. Both the industrial and academic world will profit greatly through investigations in the pure science, for which universities and endowed laboratories are most favorably situated. To this end, the industries, the universities, and The American Chemical Society should bend every effort to instill the proper spirit of research in our newly graduated chemists. A brief outline of "A Plan for Incentive to Research" is given. This is based upon monetary reward for original contributions to the literature. The extent of such reward is based upon the decision of the several boards of editors of the American Chemical Society. A fund for the purpose is of course required and to this end many industries will be glad to contribute. Freedom to select any particular university and to work under the direction of a personally chosen authority is shown to be an absolute necessity for the proper growth of research talent both on the part of instructor and student.

The economic status of the chemist: A. M. COMEY. Discussion of average salaries received by research chemists in a number of laboratories, January 1, 1920, compared with those received January 1, 1915. Average present salaries received by research chemists in a number of laboratories according to the number of years out of college.

Crystal growth in bearing metals: E. G. MAHIN. It is shown in this paper that gamma tin-antimony and epsilon tin-copper crystals grow appreciably in tin base bearing metals, at temperatures at or slightly below the lower border of their temperature range of formation. Specimens of chill cast bearing metals were heated to various stated temperatures, in many cases these being immersed in glycerine to prevent oxidation. After periods varying from one to four hours the specimens were examined and the crystals were measured.

The specific heat of petroleum at different temperatures: F. W. BUSHONG and L. L. KNIGHT. The results obtained together with those taken from chemical literature were presented in the form of curves. They show that the specific heat of the petroleum hydrocarbons, including paraffin, is proportional to, or a function of, the absolute temperature.

The filter press: D. R. SPERRY. The paper described the general principle of the filter press, the different arrangements possible, the materials filter presses can be constructed of, means of feeding and piping the filter press with a discussion of pumps appropriate for handling various substances and the method of attack to be used in selecting the proper arrangement for the filtration of several widely different substances. The different filtering mediums also were discussed.

Chemical corrosion: D. T. SHAW. Two types of corrosion are discussed, (1) Static Corrosion, (2) Velocity Corrosion in which the corroding liquid passes across the test piece at velocities from 8 ft./min. to 1400 ft./min. Under Static Corrosion, the effect of various factors affecting the rate of corrosion was studied as follows: (1) The shape of the test piece, within reasonable limits, has no effect. (2) The volume of the corroding liquid, above a certain minimum, is without influence. (3) The effect of concentration depends upon the solubility of the metal or of the corrosion product. (4) Temperature has a profound influence, it having been proved that the logarithm of the corrosion rate varies directly as the temperature. (5) The time of exposure of the test piece to the corroding liquid must be long to eliminate initial corrosion effects. (6) The test piece after the test should be cleaned by hand polishing with some mild abrasive such as "Old Dutch Cleanser."

A new type of catalyser for hydrogenation: W. D. RICHARDSON. The new type of metallic catalyzer described is the invention of Mr. Benjamin

W. Elder and is covered by U. S. Patents. It is decidedly active and the activity increases in proportion to the fineness of the abrasive used and the length of time the mill is operated. The activity curve of hydrogenation rises at first with this catalyzer and reaches a maximum before declining. The catalyst prepared by this process is certainly metallic in nature and not a sub-oxide, therefore proving that a sub-oxide nickel catalyzer is not essential for hydrogenation. Since the nickel shot has been subjected to a temperature above the melting point of nickel (1470° C.), it is obvious that the previous theory that high temperatures are inimical to catalytic material must be revised, although the facts in connection with the preparation of chemical catalyzer by the reduction of nickel oxide are well known, low temperatures producing active, high temperatures inactive catalysts. The Elder process is of great importance in a practical way and for the theory of catalytic action.

Sulfites as standards for oxidising reagents: S. LANTZ SHENEFIELD, FRANK C. VILBRANDT and JAMES R. WITHROW. The use of sulfur dioxide gas as a standard for iodine or permanganate titration is beset with the host of troubles which are always possible when attempting to predestinate the content of a gas mixture in which one component is water soluble. This paper endeavors to point out the possibilities of using a weighable sulfite, preferably the heptahydrate of sodium sulfite which is mentioned in the literature for standardization purposes. A systematic correlation of the literature from this point of view is given.

Crystalline structure of paraffine wax: D. B. MAPES. A method is described for determining the structure of the wax for the purpose of ascertaining the quality in advance of the actual sweating and pressing. Paraffine distillate from petroleum is dissolved in chloroform, the solution chilled and centrifuged. The wax layer obtained is examined microscopically, while a low temperature is maintained by means of a constant temperature slide.

Mid-continent gasoline: C. K. FRANCIS. The characteristics and methods of determining these properties were described, applying particularly to gasoline made from petroleum and natural gas of the mid-continent district. The deposit in automobile cylinders, commonly called "carbon" is, in reality, sulphur, this substance being found in crude gasoline only in very minute quantities. But gasoline is often placed on the market with large quantities of sulphur introduced during the process of refining.

The relation of chemistry (analytical and thermal) to the fabrication of steel: J. CULVER HARTZELL.

The relation of the electric furnace to the fabrication of carbon and alloy steels with special reference to the chemical and physical changes produced: J. CULVER HARTZELL.

Industrial uses of activated charcoal: O. L. BARNEBEY.

Inclusions and ferrite crystallisation in steel: II. Solubility of inclusions: E. G. MAHIN. It was shown in an earlier paper that non-metallic inclusions undoubtedly cause separation of ferrite around them, from slowly cooling steel of hypoeutectoid composition. There was advanced to account for this action the hypothesis that the inclusion dissolves slightly in the austenite of hot steel and this lowers the solubility of ferrite and causes supersaturation of the latter first in the zone immediately surrounding the inclusion. In the present paper this hypothesis is tested by inserting metallic cylinders of various alloys and of special steels carrying abnormal per cents. of special elements, into normal steels. In nearly all cases heating to above the transformation range and slow cooling causes the appearance of a well defined ring of ferrite about the insert. This is presumed to be due to the migration of the elements of the inserts into the surrounding steel, this having an effect upon ferrite solubility similar to that of non-metallic inclusions. Lantern slides, made from actual photomicrographs, were shown to illustrate the experiments.

CHARLES L. PARSONS,
Secretary

(To be continued)

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.
NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, SEPTEMBER 17, 1920

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

FOSSILS AND LIFE[1]

THE DIFFERENTIA OF PALEONTOLOGY

LIKE botany and zoology, paleontology describes the external and internal form and structure of animals and plants; and on this description it bases, first, a systematic classification of its material; secondly, those broader inductions of comparative anatomy which constitute morphology, or the science of form. Arising out of these studies are the questions of relation—real or apparent kinship, lines of descent, the how and the why of evolution—the answers to which reflect their light back on our morphological and classificatory systems. By a different approach we map the geological distribution of genera and species, thus helping to elucidate changes of land and sea, and so barring out one hypothesis of racial descent or unlocking the door to another. Again, we study collective faunas and floras, unravelling the interplay of their component animals and plants, or inferring from each assemblage the climatic and other physical agents that favored, selected, and delimited it.

All this, it may be said, is nothing more than the botany and zoology of the past. True, the general absence of any soft tissues, and the obscured or fragmentary condition of those harder parts which alone are preserved, make the studies of the paleontologist more difficult, and drive him to special methods. But the result is less complete: in short, an inferior and unattractive branch of biology. Let us relegate it to Section C!

Certainly the relation of paleontology to geology is obvious. It is a part of that general history of the earth which is geology. And it is an essential part even of physical geology, for without life not merely would our series of strata have lacked the coal measures, the

[1] From the address of the president of the Geological Section of the British Association for the Advancement of Science, Cardiff, 1920.

mountain limestones, the chalks, and the siliceous earths, but the changes of land and sea would have been far other. To the scientific interpreter of earth-history, the importance of fossils lies first in their value as date-markers; secondly, in the light which they cast on barriers and currents, on seasonal and climatic variation. Conversely, the history of life has itself been influenced by geologic change. But all this is just as true of the present inhabitants of the globe as it is of their predecessors. It does not give the *differentia* of paleontology.

That which above all distinguishes paleontology—the study of ancient creatures, from neontology—the study of creatures now living, that which raises it above the mere description of extinct assemblages of life-forms, is the concept of time. Not the quasi-absolute time of the clock, or rather of the sun; not various unrelated durations; but an orderly and related succession, coextensive, in theory at least, with the whole history of life on this planet. The bearing of this obvious statement will appear from one or two simple illustrations.

EFFECT OF THE TIME-CONCEPT ON PRINCIPLES OF CLASSIFICATION

Adopting the well-tried metaphor, let us imagine the tree of life buried, except for its topmost twigs, beneath a sand-dune. The neontologist sees only the unburied twigs. He recognizes certain rough groupings, and constructs a classification accordingly. From various hints he may shrewdly infer that some twigs come from one branch, some from another; but the relations of the branches to the main stem are matters of speculation, and when branches have become so interlaced that their twigs have long been subjected to the same external influences, he will probably be led to incorrect conclusions. The paleontologist then comes, shovels away the sand, and by degrees exposes the true relations of branches and twigs. His work is not yet accomplished, and probably he never will reveal the root and lower part of the tree; but already he has corrected many natural, if not inevitable, errors of the neontologist.

I could easily occupy the rest of this hour by discussing the profound changes wrought by this conception on our classification. It is not that orders and classes hitherto unknown have been discovered, not that some erroneous allocations have been corrected, but the whole basis of our system is being shifted. So long as we were dealing with a horizontal section across the tree of life—that is to say, with an assemblage of approximately contemporaneous forms—or even with a number of such horizontal sections, so long were we confined to simple description. Any attempt to frame a causal connection was bound to be speculative. Certain relations of structure, as of cloven hoofs with horns and with a ruminant stomach, were observed, but, as Cuvier himself insisted, the laws based on such facts were purely empirical. Huxley, then, was justified in maintaining, as he did in 1863 and for long after, that a zoological classification could be based with profit on "purely structural considerations" alone. "Every group in that [kind of] classification is such in virtue of certain structural characters, which are not only common to the members of that group, but distinguish it from all others; and the statement of these constitutes the definition of the group." In such a classification the groups or categories—from species and genera up to phyla—are the expressions of an arbitrary intellectual decision. From Linnæus downwards botanists and zoologists have sought for a classification that should be not arbitrary but natural, though what they meant by "natural" neither Linnæus nor his successors either could or would say. Not, that is, until the doctrine of descent was firmly established, and even now its application remains impracticable, except in those cases where sufficient proof of genetic connection has been furnished—as it has been mainly by paleontology. In many cases we now perceive the causal connection; and we recognize that our groupings, so far as they follow the blood-red clue, are not arbitrary but tables of natural affinity.

Fresh difficulties, however, arise. Consider

the branching of a tree. It is easy to distinguish the twigs and the branches each from each, but where are we to draw the line along each ascending stem? To convey the new conception of change in time we must introduce a new set of systematic categories, called grades or series, keeping our old categories of families, orders, and the like for the vertical divisions between the branches. Thus, many crinoids with pinnulate arms arose from others in which the arms were non-pinnulate. We can not place them in an order by themselves, because the ancestors belonged to two or three orders. We must keep them in the same orders as their respective ancestors, but distinguish a grade Pinnata from a grade Impinnata.

This sounds fairly simple, and for the larger groups so it is. But when we consider the genus, we are met with the difficulty that many of our existing genera represent grades of structure affecting a number of species, and several of those species can be traced back through previous grades. This has long been recognized, but I take a modern instance from H. F. Osborn's "Equidæ":[2]

> The line between such species as *Miohippus* (*Mesohippus*) *meteulophus* and *M. brachystylus* of the Leptauchenia zone and *M.* (*Mesohippus*) *intermedius* of the Protoceras zone is purely arbitrary. It is obvious that members of more than one phylum [*i. e.*, lineage] are passing from one genus into the next, and *Mesohippus meteulophus* and *M. brachystylus* may with equal consistency be referred to *Miohippus*.

The problem is reduced to its simplest elements in the following scheme:

a	*b*	*c*	*d*	*e*	*f*	Italics.
a	b	c	d	e	f	Lower-case Romans.
A	B	C	D	E	F	Capital Romans.
α	β	γ	δ	ϵ	ϕ	Greek.

Our genera are equivalent to the forms of letters: Italics, Roman, Greek, and so forth. The successive species are the letters themselves. Are we to make each species a genus? Or would it not be better to confess that here, as in the case of many larger groups, our basis of classification is wrong? For the paleontologist, at any rate, the lineage α, A, a, *a*, is the all-important concept. Between these forms he finds every gradation; but between *a* and *b* he perceives no connection.

In the old classification the vertical divisions either were arbitrary, or were gaps due to ignorance. We are gradually substituting a classification in which the vertical divisions are based on knowledge, and the horizontal divisions, though in some degree arbitrary, often coincide with relatively sudden or physiologically important changes of form.

This brings us to the last point of contrast. Our definitions can no longer have the rigid character emphasized by Huxley. They are no longer purely descriptive. When it devolved on me to draw up a definition of the great Echinoderma, a definition that should include all the fossils, I found that scarcely a character given in the text-books could certainly be predicated of every member of the group. The answer to the question, "What is an Echinoderm?" (and you may substitute Mollusc, or Vertebrate, or what name you please) has to be of this nature: An Echinoderm is an animal descended from an ancestor possessed of such-and-such characters differentiating it from other animal forms, and it still retains the imprint of that ancestor, though modified and obscured in various ways according to the class, order, family, and genus to which it belongs. The definitions given by Professor Charles Schuchert in his classification of the Brachiopoda[3] represent an interesting attempt to put these principles into practise. The Family Porambonitidæ, for instance, is thus defined:

> Derived (out of Syntrophiidæ), progressive, semirostrate Pentamerids, with the deltidia and chilidia vanishing more and more in time. Spondylia and cruralia present, but the former tends to thicken and unite with the ventral valve.

The old form of diagnosis was *per genus et differentiam*. The new form is *per proavum et modificationem*.

Even the conception of our fundamental

[2] 1918, *Mem. Amer. Mus. N. H.*, N. S., II., 51.

[3] 1913, Eastman's "Zittel."

unit, the species, is insecure owing to the discovery of gradual changes. But this is a difficulty which the paleontologist shares with the neontologist.

Let us consider another way in which the time-concept has affected biology.

EFFECT OF THE TIME-CONCEPT ON IDEAS OF RELATIONSHIP

Etienne Geoffroy-Saint Hilaire was the first to compare the embryonic stages of certain animals with the adult stages of animals considered inferior. Through the more precise observations of Von Baer, Louis Agassiz, and others, the idea grew until it was crystallized by the poetic imagination of Haeckel in his fundamental law of the reproduction of life—namely, that every creature tends in the course of its individual development to pass through stages similar to those passed through in the history of its race. This principle is of value if applied with the necessary safeguards. If it was ever brought into disrepute, it was owing to the reckless enthusiasm of some embryologists, who unwarrantably extended the statement to all shapes and structures observed in the developing animal, such as those evoked by special conditions of larval existence, sometimes forgetting that every conceivable ancestor must at least have been capable of earning its own livelihood. Or, again, they compared the early stages of an individual with the adult structure of its contemporaries instead of with that of its predecessors in time. Often, too, the searcher into the embryology of creatures now living was forced to study some form that really was highly specialized, such as the unstalked Crinoid *Antedon,* and he made matters worse by comparing its larvæ with forms far too remote in time. Allman, for instance, thought he saw in the developing *Antedon* a Cystid stage, and so the Cystids were regarded as the ancestors of the Crinoids; but we now find that stage more closely paralleled in some Crinoids of Carboniferous and Permian age, and we realize that the Cystid structure is quite different.

Such errors were due to the ignoring of time relations or to lack of acquaintance with extinct forms, and were beautifully illustrated in those phylogenetic trees which, in the 'eighties, every dissector of a new or striking animal thought it his duty to plant at the end of his paper. The trees have withered, because they were not rooted in the past.

A similar mistake was made by the paleontologist who, happening on a new fossil, blazoned it forth as a link between groups previously unconnected—and in too many cases unconnected still. This action, natural and even justifiable under the old purely descriptive system, became fallacious when descent was taken as the basis. In those days one heard much of generalized types, especially among the older fossils; animals were supposed to combine the features of two or three classes. This mode of thought is not quite extinct, for in the last American edition of Zittel's "Paleontology" *Stephanocrinus* is still spoken of as a Crinoid related to the Blastoids, if not also to the Cystids. Let it be clear that these so-called "generalized" or "annectant" types are not regarded by their expositors as ancestral. Of course, a genus existing at a certain period may give rise to two different genera of a succeeding period, as possibly the Devonian *Cœlocrinus* evolved into *Agaricocrinus,* with concave base, and into *Dorycrinus,* with convex base, both Carboniferous genera. But, to exemplify the kind of statement here criticized, perhaps I may quote from another distinguished writer of the present century:

> The new genus is a truly annectant form uniting the Melocrinidæ and the Platycrinidæ.

Now the genus in question appeared, so far as we know, rather late in the Lower Carboniferous, whereas both Platycrinidæ and Melocrinidæ were already established in Middle Silurian time. How is it possible that the far later form should unite these two ancient families? Even a *mésalliance* is inconceivable. In a word, to describe any such forms as "annectant" is not merely to misinterpret structure but to ignore time.

As bold suggestions calling for subsequent proof these speculations had their value, and they may be forgiven in the neontologist, if

not in the paleontologist, if we regard them as erratic pioneer tracks blazed through a tangled forest. As our acquaintance with fossils enlarged, the general direction became clearer, and certain paths were seen to be impossible. In 1881, addressing this association at York, Huxley could say:

Fifty years hence, whoever undertakes to record the progress of paleontology will note the present time as the epoch in which the law of succession of the forms of the higher animals was determined by the observation of paleontological facts. He will point out that, just as Steno and as Cuvier were enabled from their knowledge of the empirical laws of coexistence of the parts of animals to conclude from a part to a whole, so the knowledge of the law of succession of forms empowered their successors to conclude, from one or two terms of such a succession, to the whole series, and thus to divine the existence of forms of life, of which, perhaps, no trace remains, at epochs of inconceivable remoteness in the past.

DESCENT NOT A COROLLARY OF SUCCESSION

Note that Huxley spoke of succession, not of descent. Succession undoubtedly was recognized, but the relation between the terms of the succession was little understood, and there was no proof of descent. Let us suppose all written records to be swept away, and an attempt made to reconstruct English history from coins. We could set out our monarchs in true order, and we might suspect that the throne was hereditary; but if on that assumption we were to make James I. the son of Elizabeth—well, but that's just what paleontologists are constantly doing. The famous diagram of the Evolution of the Horse which Huxley used in his American lectures has had to be corrected in the light of the fuller evidence recently tabulated in a handsome volume by Professor H. F. Osborn and his coadjutors. *Palæotherium,* which Huxley regarded as a direct ancestor of the horse, is now held to be only a collateral, as the last of the Tudors were collateral ancestors of the Stuarts. The later *Anchitherium* must be eliminated from the true line as a side-branch—a Young Pretender. Sometimes an apparent succession is due to immigration of a distant relative from some other region—"The glorious House of Hanover and Protestant Succession." It was, you will remember, by such migrations that Cuvier explained the renewal of life when a previous fauna had become extinct. He admitted succession but not descent. If he rejected special creation, he did not accept evolution.

Descent, then, is not a corollary of succession. Or, to broaden the statement, history is not the same as evolution. History is a succession of events. Evolution means that each event has sprung from the preceding one. Not that the preceding event was the active cause of its successor, but that it was a necessary condition of it. For the evolutionary biologist, a species contains in itself and its environment the possibility of producing its successor. The words "its environment" are necessary, because a living organism can not be conceived apart from its environment. They are important, because they exclude from the idea of organic evolution the hypothesis that all subsequent forms were implicit in the primordial protoplast alone, and were manifested either through a series of degradations, as when thorium by successive disintegrations transmutes itself to lead, or through fresh developments due to the successive loss of inhibiting factors. I say "a species contains the possibility" rather than "the potentiality," because we can not start by assuming any kind of innate power.

Huxley, then, forty years ago, claimed that paleontologists had proved an orderly succession. To-day we claim to have proved evolution by descent. But how do we prove it? The neontologist, for all his experimental breeding, has scarcely demonstrated the transmutation of a species. The paleontologist can not assist at even a single birth. The evidence remains circumstantial.

RECAPITULATION AS PROOF OF DESCENT

Circumstantial evidence is convincing only if inexplicable on any other admissible theory. Such evidence is, I believe, afforded by paleontological instances of Haeckel's law—*i. e.,* the recapitulation by an individual during its growth of stages attained by adults in the

previous history of the race. You all know how this has been applied to the ammonites; but any creatures with a shell or skeleton that grows by successive additions and retains the earlier stages unaltered can be studied by this method. If we take a chronological series of apparently related species or mutations, a^1, a^2, a^3, a^4, and if in a^4 we find that the growth stage immediately preceding the adult resembles the adult a^3, and that the next preceding stage resembles a^2, and so on; if this applies *mutatis mutandis* to the other species of the series; and if, further, the old age of each species foreshadows the adult character of its successor; then we are entitled to infer that the relation between the species is one of descent. Mistakes are liable to occur for various reasons, which we are learning to guard against. For example, the perennial desire of youth to attain a semblance of maturity leads often to the omission of some steps in the orderly process. But this and other eccentricities affect the earlier rather than the later stages, so that it is always possible to identify the immediate ancestor, if it can be found. Here we have to remember that the ancestor may not have lived in the same locality, and that therefore a single cliff-section does not always provide a complete or simple series. An admirable example of the successful search for a father is provided by R. G. Carruthers in his paper on the evolution of *Zaphrentis delanouei*.[4] Surely when we get a clear case of this kind we are entitled to use the word "proof," and to say that we have not merely observed the succession, but have proved the filiation.

It has, indeed, been objected to the theory of recapitulation that the stages of individual growth are an inevitable consequence of an animal's gradual development from the embryo to the adult, and therefore prove nothing. Even now there are those who maintain that the continuity of the germ-plasm is inconsistent with any true recapitulation. Let us try to see what this means. Take any evolutionary series, and consider the germ-plasm at any early stage in it. The germ, it is claimed, contains the factors which produce the adult characters of that stage. Now proceed to the next stage of evolution. The germ has either altered or it has not. If it has not altered, the new adult characters are due to something outside the germ, to factors which may be in the environment but are not in the germ. In this case the animal must be driven by the inherited factors to reproduce the ancestral form; the modifications due to other factors will come in on the top of this, and if they come in gradually and in the later stages of growth, then there will be recapitulation. There does not seem to be any difficulty here. You may deny the term "character" to these modifications, and you may say that they are not really inherited, that they will disappear entirely if the environment reverts to its original condition. Such language, however, does not alter the fact, and when we pass to subsequent stages of evolution and find the process repeated, and the recapitulation becoming longer, then you will be hard put to it to imagine that the new environment produces first the effects of the old and then its own particular effect.

Even if we do suppose that the successive changes in, say, an ammonite as it passes from youth to age are adaptations to successive environments, this must mean that there is a recapitulation of environment. It is an explanation of structural recapitulation, but the fact remains. There is no difficulty in supposing an individual to pass through the same succession of environments as were encountered in the past history of its race. Every common frog is an instance. The phenomenon is of the same nature as the devious route followed in their migrations by certain birds, a route only to be explained as the repetition of past history. There are, however, many cases, especially among sedentary organisms, which can not readily be explained in this way.

Let us then examine the other alternative and suppose that every evolutionary change is due to a change in the germ—how produced we need not now inquire. Then, presumably, it is claimed that at each stage of evolution the animal will grow from the egg to the adult

4 1910, *Quart. Jour. Geol. Soc.*, LXVI., 523.

along a direct path. For present purposes we ignore purely larval modifications, and admit that the claim appears reasonable. The trouble is that it does not harmonize with facts. The progress from youth to age is not always a simple advance. The creature seems to go out of its way to drag in a growth-stage that is out of the straight road, and can be explained only by the fact that it is inherited from an ancestor. Thus, large ammonites of the *Xipheroceras planicosta* group, beginning smooth, pass through a ribbed stage, which may be omitted, through unituberculate and bituberculate stages, back to ribbed and smooth again. The anal plate of the larval *Antedon*, which ends its course and finally disappears above the limits of the cup, begins life in that lower position which the similar plate occupied in most of the older crinoids.

Here, then, is a difficulty. It can be overcome in two ways. A view held by many is that there are two kinds of characters: first, those that arise from changes in the germ, and appear as sudden or discontinuous variations; second, those that are due to external (*i. e.*, non-germinal) factors. It seems a corollary of this view that the external characters should so affect the germ-plasm as ultimately to produce in it the appropriate factors. This is inheritance of acquired characters. The other way out of the difficulty is to suppose that all characters other than fluctuations or temporary modifications are germinal; that changes are due solely to changes in the constitution of the germ; and that, although a new character may not manifest itself till the creature has reached old age, nevertheless it was inherent in the germ and latent through the earlier growth-stages. This second hypothesis involves two further difficulties. It is not easy to formulate a mechanism by which a change in the constitution of the germ shall produce a character of which no trace can be detected until old age sets in; such a character, for instance, as the tuberculation of the last-formed portion of an ammonite shell. Again, it is generally maintained that characters due to this change of germinal factors, however minute they may be, make a sudden appearance. They are said to be discontinuous. They act as integral units. Now the characters we are trying to explain seem to us paleontologists to appear very gradually, both in the individual and in the race. Their beginnings are small, scarcely perceptible; they increase gradually in size or strength; and gradually they appear at earlier and earlier stages in the life-cycle. It appears least difficult to suppose that characters of this kind are not initiated in the germ, and that they, if no others, may be subject to recapitulation. It may not yet be possible to visualize the whole process by which such characters are gradually established, or to refer the phenomena of recapitulation back to more fundamental principles. But the phenomena are there, and if any hypothesis is opposed to them so much the worse for the hypothesis. However they be explained, the instances of recapitulation afford convincing proof of descent, and so of genetic evolution.

THE "LINE UPON LINE" METHOD OF PALEONTOLOGY

You will have observed that the precise methods of the modern paleontologist, on which this proof is based, are very different from the slap-dash conclusions of forty years ago. The discovery of *Archæopteryx*, for instance, was thought to prove the evolution of birds from reptiles. No doubt it rendered that conclusion extremely probable, especially if the major premiss—that evolution *was* the method of nature—were assumed. But the fact of evolution is precisely what men were then trying to prove. These jumpings from class to class or from era to era, by aid of a few isolated stepping-stones, were what Bacon calls anticipations, "hasty and premature" but "very effective, because as they are collected from a few instances, and mostly from those which are of familiar occurrence, they immediately dazzle the intellect and fill the imagination."[5] No secure step was taken until the modern paleontologists began to affiliate mutation with mutation and species with species, working his

[5] *Nov. Org.*, I., 28.

way back, literally inch by inch, through a single small group of strata. Only thus could he base on the laboriously collected facts a single true interpretation; and to those who preferred the broad path of generality his interpretations seemed, as Bacon says they always "must seem, harsh and discordant—almost like mysteries of faith."

It is impossible to read these words without thinking of one "naturæ minister et interpres," whose genius was the first in this country to appreciate and apply to paleontology the Novum Organon. Devoting his whole life to abstruse research, he has persevered with this method in the face of distrust and has produced a series of brilliant studies which, whatever their defects, have illuminated the problems of stratigraphy and gone far to revolutionize systematic paleontology. Many are the workers of to-day who acknowledge a master in Sydney Savory Buckman.

I have long believed that the only safe mode of advance in paleontology is that which Bacon counselled and Buckman has practised, namely, "uniformly and step by step." Was this not indeed the principle that guided Linnæus himself? Not till we have linked species into lineages, can we group them into genera; not till we have unravelled the strands by which genus is connected with genus can we draw the limits of families. Not till that has been accomplished can we see how the lines of descent diverge or converge, so as to warrant the establishment of orders. Thus by degrees we reject the old slippery stepping-stones that so often toppled us into the stream, and foot by foot, we build a secure bridge over the waters of ignorance.

Francois Arthur Bather

ATLANTIC AND PACIFIC SALMON

History repeats itself with monotonous regularity and the most patent facts of scientific knowledge apparently make no impression on the people at large even where their own interests are vitally concerned. They try over and over the same experiment and after the clearly foretold results have been secured they lament the unfortunate consequences. Not only that but an expenditure of money to improve the situation is often rendered useless by action which passes without adequate protest from those most immediately interested.

In former centuries the Atlantic salmon ran yearly in the rivers of the New England coast in such numbers as to excite the amazement of our forefathers. They thought the supply inexhaustible but in 1798 a dam was erected on the Connecticut River and the results are thus described by Jordan and Evermann.

> The salmon was at one time very abundant in the Connecticut, and it probably occurred in the Housatonic and Hudson. . . . The circumstances of their extermination in the Connecticut are well known, and the same story, with names and dates changed, serves equally well for other rivers.
>
> In 1798 a corporation known as the Upper Locks and Canal Company built a dam 16 feet high at Millers River, 100 miles from the mouth of the Connecticut. For two or three years fish were seen in great abundance below the dam, and for perhaps ten years they continued to appear, vainly striving to reach their spawning grounds; but soon the work of extermination was complete. When, in 1872, a solitary salmon made its appearance, the Saybrook fishermen did not know what it was.

The experiment has been tried in many other places and each time the result has been the same. We have heard much in recent years about the dangers confronting the Pacific salmon which furnishes so important a part of the food supply of this country and of other parts of the world. Scientific men have called attention to the serious dangers which ill-considered promotion and careless destruction of spawning grounds have brought to bear on the supply of this splendid fish.

In response to these warnings President Roosevelt appointed a commission for the investigation of problems connected with the Pacific salmon and its fisheries and Congress has continued the work of studying the situation and of aiding the fish to maintain its position by the establishment and development of hatcheries. One of the oldest and most prominent is at Baird, California. It is accordingly

with grave apprehension that I have read the following paragraph in a recent publication.

> Only a few spring-run fish have been in McCloud River at Baird, California, and the dam without a fishway in the Sacramento River is to a considerable extent responsible for the condition which threatens to render the Baird hatchery useless.

In California certain state officials have suggested that since the dam was constructed without a permit from the War Department, action to correct the evil should be taken by the United States authorities. But since the Sacramento River at the point in question has not been adjudged a navigable stream, no permit was required and the matter falls legally wholly under the control of the state of California. It is pertinent to ask whether that state is so lacking in foresight and its officers so devoid of responsibility for public interests that they will continue to permit conditions that menace thus directly the public welfare.

But the question has an even broader aspect. These fish are a national asset. They are born in the waters of an individual state but they soon pass into the ocean, glean from it without expense to any state or nation the supply of energy that brings them back at stated periods to contribute to individual enterprise and to national food supply a harvest that is of all which man gathers the most profitable because it demands least care and utilizes for its production otherwise unused sources of energy.

The nation is vitally concerned with impending danger. It has contributed the means by which the hatchery is maintained and it has a moral if not a full legal right to see that no private agencies thus in irresponsible manner destroy the results of its efforts. Some way should be found and some agency invigorated to the point where it will insist upon the maintenance of proper fishways even though this involve expense upon the interests involved.

This is, however, only one phase of a question which has many aspects. The run of Pacific salmon has entirely disappeared in some streams. In others it has been tremendously impaired. In districts like Puget Sound it has sunk to a fraction of its former size and during 1919 only one district in Alaska reported a catch that equalled 100 per cent. of the number for the preceding ten years. Furthermore these results were obtained by the use of more boats, more men, more gear and other destructive appliances than had ever been in service before.

In his latest report the United States Commissioner of Fisheries calls attention to the situation in so far as it concerns Alaska waters and the salmon therein, in the following terms:

> For about eight years legislation affecting the fisheries of Alaska has been pending in Congress. Protracted hearings have been presented to the appropriate committees of the two houses. The necessity for a radical revision of the existing salmon law has been especially pointed out by various agencies and persons interested in the welfare of the fisheries of Alaska, and congressional committees have made favorable reports on bills embodying new legislation.
>
> No new fishery laws have, however, been enacted; and the fisheries of Alaska, at the most critical period of their history, remain subject to laws which have been shown to be obsolete and inadequate. The Bureau of Fisheries is thus placed at a great disadvantage in administering the salmon fisheries of Alaska and can not justly be held accountable for conditions, practises and developments which, while having the full sanction of law, are not necessarily compatible with the perpetuation of the supply and in some respects are directly opposed thereto.

Concerning the magnitude of the problem the same report speaks in another place thus:

> It is the salmon industry which gives to the fisheries of Alaska their great importance, and it was the salmon industry that contributed most notably to the increases that occurred in 1918. The value of all salmon products was $53,514,812, of which $51,041,949, represented canned fish to the number of 6,605,835 cases. Thus, 50 years after Alaska became a part of our national domain, the salmon resources alone yielded a product valued at over 7½ times the purchase price of the territory.

The public interest thus put in jeopardy is of the first magnitude and the danger both

real and immediate. Biologists know how rapidly the progress of destruction proceeds and how soon the end comes when the diminution in numbers of any species has once become conspicuous. Increasing values always lead to redoubled efforts and multiplied appliances for securing a catch and the vicious cycle gains in velocity as it decreases in diameter.

The commercial interests are strangling the goose that has laid for them so many golden eggs and some are beginning to be apprehensive for the future. Unless public sentiment can be developed, unless the efforts of the Bureau of Fisheries can be supported by adequate appropriations, and unless the taking of salmon can be subjected to reasonable restrictions that splendid fish will in a short time be as much of a luxury on the Pacific coast as its congener is to-day on the Atlantic.

Henry B. Ward

JOSEPH PANTEL (1853–1920), A JESUIT AND A SCIENTIST

The first days of last February saw the closing of a remarkable scientific career, when the death of Fr. Pantel, S.J., occurred in Toulouse, France. By dint of tireless work and scientific investigations, he had gained for himself an international reputation. He had developed a keen power of observation and was considered by all the men of science who knew him as a first class biologist.

Twice the Academy of Sciences of Paris recognized the merits of his works. In 1898, it conferred on him the "Thore Prize" for his masterly monograph on the "*Thrixion halidayanum*"; in 1906, the "Gama Machado Prize" for his studies on the cells of the masculine type of the "*Notonecta glauca.*" This second time the work had been done in collaboration with his disciple, Rev. Robert de Sinéty, S.J.

In 1891–92 he studied at Louvain University in the Carnoy Laboratory. In later years the systematic study of the Coleoptera and Orthoptera, their anatomy and biology, constituted the main guiding lines of his research work. The observations and discoveries he made were published by several scientific magazines, *La Cellule* and *Le Neuraxe*, of Louvain, and by many scientific societies, The Royal Spanish Society of Natural History, The Royal Academy of Arts and Sciences of Barcelona, the Entomological Societies of France, Holland and others.

The most famous entomologists of Europe revered his learning and admired his modesty. In his honor they designated several new species with the name of "*Panteli*" and several genera—a genus of Orthoptera "*Pantelia*" (Bolivar) and a genus of Diptera "*Panteliola*" (Rev. Kieffer). Dr. P. Halbfass, teaching in the University of Munster in 1903, spoke of Fr. Pantel in glowing terms of admiration. Being a Lutheran, he did not mention to the class that Fr. Pantel was a Jesuit but he confessed that he had been sent to study under his direction by his well-known professor, Dr. O. Hertwig, who saw in Fr. Pantel an eminent scientist.

Parasitism among insects, customs and social habits of the pirates and robbers among the winged tribe, the shameless impudence of beggarly insects which cause the death of others in order that they may live—such were the topics of interest in the studies of Fr. Pantel.

After the war the services of Fr. Pantel as professor were enlisted in the Catholic Scientific Institute of Toulouse. The writer can testify that, in the work of the class-room, Fr. Pantel was equally eminent. His lectures were always very carefully prepared and delivered, the right word always in the right place. No unnecessary repetitions that tire the mind or distract the attention. Fr. Pantel gave his lectures, guided by psychological principles and never did spare labor to obtain the best results in the shortest time. As an instance of the last assertion the writer may adduce the fact of Fr. Pantel's spending in his early career 17 hours work for the preparation of a class-room lecture lasting 55 minutes.

The number of students who came to attend his lectures was a silent testimony of the value of his teaching. They came from Spain, Por-

tugal, Italy, Germany, England, Ireland, Belgium, South America and even remote Australia.

J. H. Foulquier, S.J.

Sacred Heart College,
Denver, Colo.

SCIENTIFIC EVENTS

TRIBUTE TO THE MEMORY OF JAMES WILSON

Sympathy at the death of former Secretary of Agriculture James Wilson was sent to his family in the form of a resolution adopted at a meeting of the chiefs of the various bureaus of the United States Department of Agriculture. Tribute was paid to the former head of the department for "his patriotic devotion to the interests of all the people, his broad vision, and his practical wisdom." As a token of respect the flags on all department buildings were placed at halfstaff, and remained so until after the funeral, which took place at Traer, Iowa.

Because of the time of the funeral, the department was unable to send representatives from Washington. The department, however, designated Dr. Henry C. Taylor, Chief of the Office of Farm Management, who was in the Middle West; Frank S. Pinney, Federal agricultural statistician at Des Moines; and R. E. Doolittle, Chief of the Central Food and Drug Inspection District at Chicago, to represent it at the funeral.

A floral tribute was sent by officials and employees of the department as a token of esteem for their former chief. The message of sympathy sent the family of Mr. Wilson followed a similar personal message sent by Secretary of Agriculture Meredith. The resolution of the bureau chiefs, forwarded by Assistant Secretary of Agriculture Ball, read:

The members of the Department of Agriculture, feeling deeply the loss of their former secretary, James Wilson, of Iowa, desire to express their sympathy with his family and their appreciation of his great services to the United States as Dean of Agriculture, member of Congress, and Secretary of Agriculture. His patriotic devotion to the interests of all the people, his broad vision, and his practical wisdom place him high among those who have deserved well of their country. Beloved as a friend, admired and respected as an official, his example as a man and a statesman is one to which all Americans may turn for inspiration and emulation: Therefore be it

Resolved, That in the death of James Wilson American agriculture has lost one of its greatest exponents and American citizenship one of its finest exemplars.

In token of respect the flags on all department buildings will be placed at half-mast, and a copy of this resolution will be sent to the family.

RESEARCH IN AVIATION

An addition has been made to the activities of the Imperial College at South Kensington in the establishment of a new department of aeronautics. The movement was initiated by Sir Basil Zaharoff's endowment of the University of London chair of aviation, to which Sir Richard Glazebrook was appointed, with the duty of directing the new department.

The London *Times* states that the department was established to give effect to the scheme proposed by the committee on education and research in aeronautics in their report, dated December 12, 1919, in which the opinion was expressed that the Imperial College should become the central school for advanced study in aeronautical science. The school is administered by an advisory committee of twelve members, with Sir Arthur Acland as chairman, representing the college, the air ministry, the aeronautical research committee, the University of Cambridge, the Royal Aeronautical Society, and the Society of British Aircraft Constructors.

A comprehensive scheme of instruction and training, mainly post-graduate in character, has been arranged for next session beginning in October, including special sections in aeronautical engineering, meteorology and navigation, and with the cooperation of the Air Ministry the services have been engaged of a distinguished staff of experts. Sir Napier Shaw will be professor of meteorology; Mr. Leonard Bairstow, professor of aerodynamics; Mr. A. J. Sutton Pippard will deal with the structure and strength of aircraft, and Mr. A. T. Evans with the aircraft engines. Courses of lectures

will also be given dealing respectively with airships and with navigation, while arrangements are in hand for special instruction in air-cooled engines, high-compression engines, dopes, instruments, wireless telegraphy, and similar subjects. It has also been arranged that students will carry out part of their practical training in one or other of the government establishments concerned with aeronautics.

VARIETIES OF WHEAT

THE Department of Agriculture reports that the introduction of hard winter wheat from Russia into Kansas and other states of the central Great Plains area in the early seventies was an epoch-making event. The growing of these Crimean wheats, especially the Turkey and Kharkov varieties, has been the principal cause of the prosperous development of much of that section. The development and distribution of Kanred, an improved strain of hard red winter wheat, may prove equally epoch-making in the history of Kansas. Kanred is one of the most important examples of the improvement of wheat by the method of pure line selection. It is the product of a single head, selected in 1906 at the Kansas Agricultural Experiment Station. Its true value was determined only after many years of careful experiments, but as a reward not fewer than 500,000 acres were sown in the State of Kansas alone in the fall of 1919. Since 1917, Kanred has been under experiment in many states other than Kansas. Last fall many thousands of bushels were introduced into other states for commercial growing. Kanred is unusually well adapted to many of the varying conditions in the state of Kansas. Its principal advantage over Turkey and Kharkov is its resistance to some forms of both stem rust and leaf rust. It has other advantages, however, such as slightly greater winter hardiness, earlier maturity, and makes better pasture. Those factors have caused it to outyield the Turkey and Kharkov wheats in most sections of Kansas by 3 to 5 bushels per acre. The same factors may or may not be as important in other states.

To determine the varieties of Australian wheat best adapted to conditions on the Pacific coast, the United States Department of Agriculture has conducted a series of experiments which accurately ascertained the yield and quality of those varieties already of commercial importance in that region, as well as other varieties, samples of which were brought direct from Australia. In connection with the latter phase of the investigation more than 130 samples of wheat were obtained, representing 92 distinct varieties. Results from the early experiments with these wheats show that the "Federation group," consisting of three varieties, Federation, Hard Federation, and White Federation, is probably the best suited to this western region. These three varieties were compared in yield with the leading commercial wheats, including the Bluestem, Australian varieties, Pacific, White Australian, and Early Baart, and produced higher yields, according to the department's cereal specialists. Hard Federation produced the larger yields in Oregon, while White Federation did better in California. Milling experiments indicate that Hard Federation is equal or superior for milling and bread-making purposes to the leading commercial varieties now grown on the Pacific coast and also superior in this regard to Federation and White Federation.

LECTURES AT THE NEW YORK BOTANICAL GARDEN

FREE public lectures are being delivered in the lecture hall of the museum building, Saturday afternoons, at four o'clock, as follows:

Sept. 4. "How to can fruits and vegetables," Professor H. D. Hemenway.

Sept. 11. "What Columbus saw in the new world," Dr. W. A. Murrill.

Sept. 18. "National losses due to plant diseases," Dr. M. T. Cook.

Sept. 25. "Dahlias and their culture," Dr. M. A. Howe.

(Exhibition of Dahlias, Sept. 25 and 26)

Oct. 2 "Nuts and other food crops from trees," Dr. W. C. Deming.

Oct. 9. "Evergreens," Mr. G. V. Nash.

Oct. 16. "Autumn colors," Dr. A. B. Stout.

Oct. 23. "Women as horticulturists," Miss E. L. Lee.

Oct. 30. "The plant life of the south," Dr. F. W. Pennell.

Free public lectures on Sunday afternoons, at four o'clock, are as follows:

Sept. 5. "Ceylon, the Pearl of the Orient," Dr. H. A. Gleason.

Sept. 12 "The vegetation of Alaska and its significance," Dr. Arthur Hollick.

Sept. 19. "Planting to attract our native birds," Dr. G. C. Fisher.

Sept. 26. "How plants get their food," Mr. Norman Taylor.

(Exhibition of Dahlias, Sept. 25 and 26)

Oct. 3. "Plant motives in Renaissance decorative art," Dr. W. A. Murrill.

Oct. 10. "Recent plant immigrants and new American plant industries," Dr. David Fairchild.

Oct. 17. "Poisonous plants in fields and woodlands," Dr. Wm. Mansfield.

Oct. 24. "House plants: their care and culture," Mr. H. Findlay.

Oct. 31. "The dehydration of foods," Dr. B. H. McKee.

Free public lectures in the central display greenhouse, Conservatory Range 2, on Saturday afternoons, at three-fifteen o'clock, will be as follows:

Nov. 6. "Palms and their products," Dr. N. L. Britton.

Nov. 13. "Tropical aquatic plants," Mr. G. V. Nash.

Nov. 20. "Tropical beverage plants," Dr. H. A. Gleason.

Nov. 27. "Bananas and their relatives," Dr. W. A. Murrill.

Dec. 4. "Tropical plants yielding starch," Dr. M. A. Howe.

Dec. 11. "Plants yielding rubber," Dr. A .B. Stout.

SCIENTIFIC NOTES AND NEWS

SIR EDWARD THORPE, emeritus professor of chemistry in the Imperial College of Science, London, has been elected president of the British Association for the Advancement of Science for the meeting to be held next year at Edinburgh. Sir Charles Parsons has been elected a trustee in the place of the late Lord Raleigh. It was found impracticable to go to Colombo in 1922, and an invitation from Hull has been accepted for that year.

DR. LEONARD G. ROWNTREE, professor of medicine in the medical school of the University of Minnesota, and Dr. Reginald Fitz, associate in medicine of the Massachusetts General Hospital, have joined the staff of the Mayo Foundation for Medical Education and Research, at Rochester, Minn. Drs. Rowntree and Fitz will be associated in the further development of research in internal medicine.

MR. W. D. COLLINS, of the Bureau of Chemistry, U. S. Department of Agriculture, has been appointed chief of the quality-of-water division of the U. S. Geological Survey.

MR. EARL P. CLARK, assistant in chemistry at the Rockefeller Institute for Medical Research, New York City, has joined the chemical staff of the Bureau of Standards.

DR. H. S. HELE-SHAW, Harrison professor of engineering in University College, Liverpool, 1886–1903, and in the university from 1903–04, has been elected emeritus professor of engineering in the University of Liverpool.

THE following degrees have been conferred by the University of Dublin: doctor of science, Sir William H. Bragg; doctor of medicine, Sir Archibald E. Garrod; doctor of law, Sir Donald Macalister.

MR. H. S. BAILEY, formerly of the Bureau of Chemistry, U. S. Department of Agriculture, resigned his position with E. I. du Pont de Nemours and Company on July 1, to take charge of research for the Southern Cotton Oil Company at Savannah, Georgia.

B. S. BUTLER has resigned from the U. S. Geological Survey, and will be associated with L. C. Graton in a study of the geological problems of the Calumet and Hecla mines.

D. H. NEWLAND has resigned as assistant state geologist of New York, and has taken a position with the Beaver Board Companies of Buffalo, New York, as field geologist and mining expert.

MAJOR LAWRENCE MARTIN, of the General Staff, and one of the map experts of the Army, who has been on duty in the Military Intelligence Division, has been ordered to report to

the secretary of state for temporary duty for the purpose of assisting in preparing a report on the proposed western boundary of Armenia. The report is intended to aid President Wilson in considering questions relating to the boundaries of Armenia. Major Martin was formerly associate professor of physiography and geography in the University of Wisconsin. He was chief of the Geographical Branch of Military Intelligence, attached to the American Commission to Negotiate Peace, from November, 1918, to December, 1919. One of his details while at the Peace Conference was that of geographer to General Harbard's Military Mission to Armenia

W. T. Thom, Jr., of the U. S. Geological Survey, who has been doing relief work in Vienna, Austria, for the past six months, has returned to Washington.

Dr. M. X. Sullivan, biochemist of the U. S. Public Health Service, gave a course of sixteen lectures on "Public Health" at the Converse College Summer School and Red Cross Institute for social workers, Spartanburg, South Carolina.

A lecture entitled "News from the stars," under the auspices of the University of California Extension Division by Dr. R. H. Aitken, astronomer at the Lick Observatory, will be delivered before the Fresno County Medical Society at the University Club, open to the public, to begin the program of lectures for the fall by the university extension division of the University of California.

Joseph Paxon Iddings, formerly geologist of the United States Geological Survey and professor of petrology in the University of Chicago, distinguished for his work on igneous rocks, died on September 8, at the age of sixty-three years.

Samuel Mills Tracy, agronomist of the United States Department of Agriculture, died at Laurel, Miss., on September 5, aged seventy-three years. Dr. Tracy was born at Hartford, Vermont, and graduated from Michigan State Agricultural College in 1868. From 1877 to 1887 he was professor of botany and agriculture at the University of Missouri, and from 1887 to 1897 was director of the Mississippi Agricultural Experiment Station. Since that time he has been attached to the United States Department of Agriculture. He was a fellow of the American Association for the Advancement of Science, in the work of which he took an active part, and a member of the New Orleans Academy of Science, and the Botanical Society of America. Among his works are the "Flora of Missouri," the "Flora of Southern United States" and numerous bulletins issued by the Mississippi Experiment Station and the United States Department of Agriculture.

Ellis L. Michael, zoologist of the Scripps Institution for Biological Research of the University of California from the foundation of the institution fifteen years ago, died at La Jolla, California on August 30. A correspondent writes: "Mr. Michael did notable work on the Chætognatha, and in the broader field of quantitative and statistical treatment of problems in marine planktology. So few are the workers in this domain of biology that his loss is specially heavy." Mr. Michael had just passed his thirty-ninth birthday.

Edward Kinch died on August 6 at the age of seventy-one years. Professor Kinch was from 1881 to 1915 professor of chemistry at the Royal Agricultural College, Cirencester.

The death is announced at Cassel, Germany, of Dr. M. Alsberg, the anthropologist, at the age of eighty years.

About forty members of the British Society of Glass Technology are visiting American glass plants. A joint meeting of the glass division of the American Ceramic Society and the British Society of Glass Technology was held in Pittsburgh on September 1, 2 and 3.

A federation of the biological clubs affiliated with the Paris Biological Society was recently formed in the laboratory of Professor Brachet in the anatomical laboratory of the University of Paris. The clubs of Brussels, Lille, Lyons, Nancy, Strasbourg, Bucharest and Copenhagen were represented. Professor Bard, of Strasbourg, was elected president and the next meeting is scheduled at Strasbourg in the autumn of 1921.

THE Air Ministry, in an official *Notice to Airmen*, according to the London *Times*, details innovations recently introduced in the dissemination of meteorological statistics and forecasts by wireless telegraphy for the use of aircraft. Reports are issued from the Croydon aerodrome on a 900-meter continuous wave each day, including Sundays, at hourly intervals between 7.35 A.M. (G.M.T.) and 4.35 P.M., the data in each consisting of observations made 35 minutes previously at the following places: Felixstowe, Croydon, Biggin Hill, Lympne, Beachy Head, Dungeness, and Botley Hill (North Downs). In addition to the usual information, the messages now include the direction and speed of the low cloud, the character of the sea-swell and the visibility towards the sea is distinguished from that over the land, the latter important feature being observed at various points along the channel coast. A statement is also added regarding the conditions prevailing on the North Downs as viewed from Biggin Hill, while at 8.25 A.M. the complete results of a pilot-balloon ascent at Croydon or Lympne are appended whenever available. Every statement is suffixed by the latest Meteorological Office estimate of the probable weather during the remaining hours of daylight. Reports of a similar character are also issued on the same wave-length from Le Bourget seven times daily, the observations transmitted in this case being derived from St. Inglevert, Abbeville, Maubeuge, Havre, and Le Bourget.

THE department of hygiene and public health at King's College, London, which offers complete courses of instruction for the various degrees and diplomas in public health, has recently been reorganized under the general supervision of Professor Simpson. Professor Sommerville, lectures on hygiene, sanitary law and administration, sanitation and vital statistics, etc., and Mr. Rhys Charles on the Food and Drugs Acts. Bacteriology and parasitology is taught by Professor Hewlett and Dr. Taylor, and the chemical laboratory work is in charge of Mr. William Partridge. The laboratories are open daily for instruction and research, and arrangements are made to suit the convenience of those engaged in practise. Weekly demonstrations on sanitary appliances and visits to places of sanitary interest are arranged. A special course on industrial hygiene is given by Dr. Legge (October to February) and courses on school hygiene are given by Dr. Malcolm (October to June).

As the part of the university extension work the Boston Teachers' School of Science will offer this fall courses in botany, geography, geology and zoology. The courses will be given by Professor W. J. V. Osterhout, of Harvard, Professor Elizabeth F. Fisher, of Wellesley; Professor George H. Barton and Professor George H. Parker, of Harvard. The school also announces its autumn course of field lessons in geology as follows: September 11, Baker Bridge; September 18, Andover; September 25, Braintree; October 2, Wayland; October 9, Orient Heights; October 16, Naugus Head; October 23, Roberts; October 30, West Quincy; November 6, Kendal Green.

UNIVERSITY AND EDUCATIONAL NEWS

THE University of Buffalo has received from O. E. Foster a gift of $400,000 for the erection of a chemistry building. It has also received anonymous gifts of $250,000 toward endowment and of a library building.

THE late Dr. J. G. Bartholomew has bequeathed to the University of Edinburgh the sum of £500, to be applied towards the foundation of a chair in geography.

RECENT appointments at Harvard University include those of Richard D. Bell, assistant professor of biological chemistry; W. T. Bovie, Ph.D., '14, assistant professor of biophysics and instructor in bacteriology; Stanley Cobb, '10, assistant professor of neuropathology; Calvin G. Page, '90, assistant professor of bacteriology; Marshal Fabyan, '00, assistant professor of comparative pathology; Joseph C. Aub, '11, assistant professor of physiology; Robert B. Osgood, '89, instructor in orthopedic surgery, and James B. Ayer, '03,

and Lesley H. Spooner, '03, instructors in neurology and bacteriology, respectively.

In the department of chemistry of the West Virginia University the following additions have been made to the teaching staff: Dr. C. A. Jacobson, professor; Dr. E. C. H. Davies, associate professor; Lily B. Sefton, assistant professor, and A. E. Owens, instructor.

New additions to the staff of the division of agricultural biochemistry at the University of Minnesota are: instructors, Arthur K. Anderson, Paul F. Sharp and G. S. Taylor; assistants, Walter F. Hoffman, Earl R. Norris, Martin W. Sandstrom, Clifton W. Ackerson and Edward F. Danielson. S. D. Wilkins, special analyst, recently resigned to enter commercial work and his position has been filled by the appointment of Mr. Arnold H. Johnson.

David F. McFarland, M.S. (Kansas), Ph.D. (Yale), formerly associate professor of industrial chemistry and metallurgy at the University of Illinois, has been appointed professor and head of the department of metallurgy in the school of mines of the Pennsylvania State College.

Dr. Joshua M. Slemons, professor of obstetrics and gynecology in Yale University School of Medicine, New Haven, has resigned and is succeeded by Dr. Arthur H. Morse.

Dr. Ardrey W. Downs, formerly assistant professor of physiology at McGill University, Montreal, has accepted the chair of physiology in the University of Alberta.

Dr. W. S. Lazarus-Barlow has been appointed to the university chair of experimental pathology at Middlesex Hospital Medical School, London.

DISCUSSION AND CORRESPONDENCE

GALILEO'S EXPERIMENT FROM THE LEANING TOWER

To the Editor of Science: Professor Cajori's article entitled "Aristotle and Galileo on Falling Bodies"[1] recalled to mind a question recently asked by a member of the department of science in this school. The question was: "Just what experiment did Galileo perform from the leaning tower of Pisa?" The writer did not know, and endeavored to find out, without success. Some notes he made may be of interest.

Poggendorf, "Geschichte der Physik," p. 224, 1879, says "Galileo dropped balls of different sizes" and gives no citation of authority.

Rosenberger, "Geschichte der Physik," 1882, Vol. I., p. 141, states that Galileo proved by experiment from the leaning tower of Pisa in 1590 that light bodies fall as fast as heavy bodies. No citation.

The same author in Vol. II., p. 16, states that Galileo let fall stones singly and tied together and they fell in the same time. Also says that Galileo dropped a 100 lb. shot and a ½ lb. shot and that they reached the ground not the width of a hand apart. No citation.

Heller, "Geschichte der Physik," Vol. I., p. 346, 1882, states that Galileo dropped from the leaning tower of Pisa, pieces of wood, lead and marble and that they fell in nearly the same time. No citation.

Cajori[2] gives a circumstantial account of the celebrated experiment and says, "One morning before the assembled university, he ascended the leaning tower, and allowed a one pound shot and a one hundred pound shot to drop together. The multitude saw the balls start together, fall together, and heard them strike the ground together." No citation.

Apparently all of the above statements have their foundation in Viviani's "Racconto Istorico di Vita di Galileo Galilei," written some time after 1654, at the request of Leopold of Tuscany. Viviani[3] states that Galileo demonstrated by repeated experiments made from the leaning tower of Pisa that bodies of different weights falling through the same medium move with equal velocity. He also states that the experiments were made in the presence of the other readers, philosophers and all the students. Viviani knew Galileo from

[1] Science, 60, 615, 1920.

[2] "History of Physics," p. 32, 1899.

[3] "Opere di Gal.," Edizione Nazionale, XIX., p. 606.

1639 to Galileo's death in 1642. In 1639 Viviani was seventeen years old.

No account by Galileo himself is to be found in the Edizione Nazionale of his works, if the elaborate index is to be trusted. Further as Gerland, "Geschichte der Physik," p. 316, 1913, points out, Galileo in his treatise "De Motu," which dates from the time of his readership in the University of Pisa, cites experiment from a high tower as proving that wood at the beginning of its fall moves more rapidly than lead, but that a little later the lead will pass the wood and will precede the wood by a great space. Galileo further states, "and on this I have made experiment frequently."[4]

Renieri (born in 1606, knew Galileo from 1633 to 1642 and during that time wrote Galileo at least sixty letters) wrote a letter to Galileo dated March 13, 1641,[5] in which he gives an account of some experiments performed by Renieri from the leaning tower of Pisa. Renieri dropped a sphere of wood and one of lead the same size; on reaching the ground the lead was three "braccia" ahead of the wood. He also dropped a cannon ball and a musket ball and on reaching the ground the cannon ball was a palm ahead. Renieri makes no reference to Galileo's experiments, which is difficult to explain except on the ground that he had never heard of them.

Realizing the slippery nature of historical deduction, I draw no conclusion except this, that we do not know exactly what experiment Galileo performed from the leaning tower.

EDW. A. PARTRIDGE
WEST PHILADELPHIA HIGH SCHOOL

THE BOOMING LIZARD OF AUSTRALIA

IN July, 1913, I was hunting in the Cove's River Ranges with two companions—Andrew and John Duncan, of Megalong. We found a black-and-yellow banded monitor lizard about five feet long concealed in a crevice on the face of a wall. We had no intention of injuring him, but out of mischief Andrew Duncan suggested that we should make him yell. I was sceptical, but both men assured me that the lizard could, and would yell under persuasion. On condition that there should be no cruelty, I consented to a demonstration. They laughed at the idea of cruelty. Andrew picked up a stick and began poking the reptile in the ribs and tickling him under the arm. It stood it for a while, merely squirming closer down in the crevice, then, having had enough of it, blew himself out and emitted a most comically doleful bellow that could be heard several hundred yards away. This he did repeatedly until we had laughed ourselves tired. It was funny, on looking back after we had gone fifty yards, to see the lizard stick his head around the corner to make sure that we had really departed.

I have had for the last four years at my hunting-box on the Naltai River, a tame monitor whom I have called "Joseph" on account of his coat of many colors, and who is the interesting companion of my solitude—and incidentally keeps the snakes away. With the above in my mind, I experimented on him. I found him camped under the bench beneath the window, and irritated him with the end of a stick. He did as the other had done—filled himself with wind and then emitted it in a prolonged bellowing groan. By the way, our "bookbook owl" does much the same thing. He fills himself nearly to bursting in a succession of gasps, and then says "Hoo-hoo hoo" till he has no more breath, then fills up again.

WALTER H. BONE
LINNÆAN SOCIETY OF NEW SOUTH WALES,
SYDNEY

[4] Op. Ed. Naz. I., 334.

[5] Op. di. Gal. Ed. Naz., 18, p. 305.

QUOTATIONS

THE BRITISH ASSOCIATION

THE British Association begins its annual meeting at Cardiff to-day. Our correspondents report that the increase in railway fares has not reduced the attendance below that of a fair average, and that the arrangements made for the housing of the visitors and the accommodation of the sectional meetings are excellent. By a useful innovation the daily

Journal has been replaced by a single issue covering the whole meeting. Clearly it will be a strenuous time. To-day eleven of the twelve sectional presidents deliver their addresses, on subjects ranging from the constitution of the stars to the intensive cultivation of gooseberry bushes. The detailed proceedings of the sections in the morning and the afternoon should be full of interest. An announcement is to be made as to the third of the three practical tests proposed by Einstein for his new theory of relativity, two having been already successfully passed. The chemists are to consider the production of alcohol for industrial purposes. The geology of the district and the possible effect of the narrow valleys in provoking feelings of imprisonment and isolation on their thronged population are to engage the attention of the geologists and geographers—unfortunately, in two separate sections. The economists are to discuss decimal coinage, the Danish credit system, and the business side of agriculture, while the agriculturists are busy over the growing of potatoes. The importance of psychology, the mental effects of alcohol, and training in citizenship are all on the day's program. In the evening, Professor Herdman, president-elect, will be inducted into the chair, and will discourse on Oceanography and Fisheries. The following days, if not quite so arduous, are at least to be well filled. Since the Association held its first meeting, at York in 1831, there has been a great advance in science, and an increasing specialization of its branches. At first there were only six sections, and the next year, at the Oxford meeting, these were reduced to four, dealing respectively with mathematics and physics, chemistry, mineralogy and electricity, geology and geography, biology. By 1855 they had grown to seven; they are now twelve, and a proposal for still further sub-division is to be discussed. We wonder if it is all gain. The reverse tendency is also at work, and several sections are to combine for occasional joint discussions. There is much to be said in favor of a concentration at the annual meetings on subjects whose problems concern many different branches of science and require illumination from many points of view.—*The London Times*.

SPECIAL ARTICLES

EXPERIMENTS IN THE TRANSPLANTATION OF THE HYPOPHYSIS OF ADULT RANA PIPIENS TO TADPOLES

The writer has for some time past been engaged in experiments upon the extirpation of the hypophysis and the thyroid glands of tadpoles. These experiments have yielded interesting results. Absence of the thyroid gland wholly prevents metamorphosis while the removal of the pars buccalis of the hypophysis, *i. e.*, all but the posterior lobe brings about the following results:

1. Failure to metamorphose.
2. Retardation of growth in size.
3. A striking change in color from black to a silver white.
4. Lowered resistance to unfavorable conditions.

Experiments in transplanting of the hypophysis were undertaken by the writer two years ago, but failed because of faulty technique, and were for the time being abandoned owing to press of other work. This year the experiments were carried through with surprisingly little difficulty and have given such striking results that it seems well worth while to offer a brief and necessarily rather superficial account of them at this time. These experiments are based on 384 operations upon tadpoles.

It is well known that the hypophysis is composed of four elements: the anterior lobe, intermediate lobe, pars tuberalis, and posterior lobe. All but the last named come from the same embryonic anlage—the portion that has been removed in the extirpation experiments mentioned. For the sake of brevity we shall speak of these as "pituitaryless" tadpoles. For the present work three out of the four lobes—all except the pars tuberalis—were employed. In each case a fair amount of care is exercised to prevent infection but the precautions are in no case perfect. Greatest reliance is placed upon the remarkable resist-

ance of the tadpoles to infection. In each case the portion transplanted is placed in a pocket under the skin above the right eye. A delicate knife made from a needle ground to a cutting edge is used in making the pocket into which the piece of material is thrust.

The chief aim of these experiments is to study the several functions of the different portions of the hypophysis. It is quite easy to separate the anterior lobe from the other portions but the intermediate and posterior lobes are tightly applied together although the difference in texture makes it quite easy to distinguish them. In a large portion of the experiments these lobes were both transplanted together. In other series they were laboriously dissected apart and separately transplanted.

The experiments show in clearest fashion that each part functions quite differently from the others.

1. The anterior lobe transplanted to normal, to pituitaryless, and to thyroidless tadpoles in each case produces a marked acceleration of growth so that the tadpoles thus treated are conspicuously larger than those into which the other parts of the hypophysis have been transplanted. They are larger than normal controls and larger than controls into which muscle tissue has been transplanted in the same way and at the same time as the above operations.

The anterior lobe also produces a marked acceleration in the development of the hind legs. This happens to be most conspicuous in the pituitaryless specimens probably because they were the first operated; but at the date of writing—June 14th—the same appears to be true of the normal and the thyroidless specimens into which this lobe has been transplanted. The white pituitaryless tadpoles into which this lobe has been transplanted show not the slightest tendency to return to the original black color except for a slight temporary tendency at the beginning. This may be due to the adhesion of particles of the intermediate lobe or to a certain amount of secretion that had diffused from the latter. It soon clears up however.

2. Normal tadpoles into which the intermediate lobe is engrafted become much more darkly colored than the controls, while those which have been made to turn white as a result of removal of the anlage of the hypophysis exclusive of the posterior lobe are made to change back from white to black when the intermediate lobe is engrafted into them. There is not the slightest doubt that this lobe is responsible for the conspicuous color changes controlled by the hypophysis. This return to the black color takes place slowly, being scarcely completed inside of ten days. Specimens into which the intermediate and posterior lobes together have been transplanted show this phenomenon of deepening of the black pigmentation as well as those into which the intermediate lobe alone has been engrafted.

3. Tadpoles into which the combined intermediate and posterior lobes are transplanted show not only the color change mentioned above but they also suffer a marked contraction of the body walls. Within twelve hours they appear very emaciated. This characteristic gradually disappears, in the course of ten days. These tadpoles show apparent retardation of growth. When the intermediate and posterior lobes are dissected apart and transplanted separately it is seen that this phenomenon is wholly due to the posterior lobe. It is probably caused by the well-known property that this portion of the hypophysis possesses for bringing about muscular contraction. The details of this will need further study. The posterior lobe does not produce a restoration of the black color to pituitaryless tadpoles.

In summing up it may be said that although we have not taken the pars tuberalis into account and can not make a complete analysis of the functions of the different parts of the hypophysis until we do, the following conclusions are justified.

1. The anterior lobe of the hypophysis stimulates growth and metamorphosis.

2. The intermediate lobe is very largely if not wholly concerned in regulating such color changes as are controlled by the hypophysis.

3. The posterior lobe causes marked contraction of the body walls and at least apparent retardation in growth.

BENNET M. ALLEN
DEPARTMENT OF ZOOLOGY,
UNIVERSITY OF KANSAS,
June 14, 1920

THE AMERICAN CHEMICAL SOCIETY. VII

The determination of the specific heat of heavy mineral oils: HERBERT BAILEY and C. B. EDWARDS. There is apparently very little information available concerning the specific heats of heavy mineral oils at temperatures of 150°–250° C. Such information is often needed in connection with the proper design of plants in which such oils are used as the heat transfer medium. In order to ascertain the specific heat of a particular oil over short temperature intervals between 120°–235° C. a simple apparatus was devised, consisting of a quart vacuum jacketed fruit jar, a small electrically heated resistance coil, and a motor driven glass stirrer. After obtaining, experimentally, the water equivalent of this calorimeter, and its cooling curve, measurements were made of the rate of rise in temperature of a definite amount of oil in the apparatus when heated with a nearly uniform input of electrical energy. For the particular oil varied from 0.543 for the range 120°–140° C. to investigated, it was found that the specific heat 0.630 between 215°–235° C.

The freezing points of mixtures of sulphuric and nitric acids: W. C. HOLMES. Freezing points were determined on three sets of mixtures of sulphuric and nitric acids, having total acidities of 100 per cent., 95 per cent. and 103 per cent. respectively, in which the content of nitric acid was varied from 0 to 50 per cent. In the case of the 100 per cent. acidity mixtures, the freezing point of the sulphuric acid was depressed by the addition of nitric acid until a minimum was reached, when 5.5 per cent. HNO_3 was present. On further increasing the nitric content, a sharp rise in the freezing point to 2.3° took place, with a nitric content of approximately 11 per cent. It seemed probable that the composition at this maximum represented a definite chemical compound between sulphuric and nitric acids, the acids being present at that point in the proportion $5H_2SO_4$–HNO_3. The freezing point curve showed a similarity to that of sulphuric acid and water. The freezing point curve for the 95 per cent. and 103 per cent. mixtures showed a general similarity to that of the 100 per cent. acids, and possessed similar maxima and minima. They were complicated by the presence of a third constituent, water and free sulphur trioxide, respectively.

Strength and velocity of detonation of various military explosives: W. C. COPE. The strength of various military explosives that were used or proposed for use during the European War has been determined by the ballistic mortar in terms of TNT which is taken as a standard. Several explosives not used for purely military purposes are also given for comparison to aid in fixing the comparison in the mind. The velocity of detonation of several explosives confined in iron pipes $1\frac{3}{16}''$ inside diameter was determined by the Dautriche method and compared with TNT. The velocities ranged from 5,870 to 7,600 m./sec. Several explosives contained in three inch base detonating shells were detonated and the resulting fragments compared using TNT as a standard.

Potash and reconstruction: J. W. TURRENTINE. Since the signing of the armistice, when most of the American potash-producing plants suspended operations, imports of foreign potash have not been great enough to supply America's requirements even at the lower prices prevailing. The situation is critical, for the American industry has been demoralized and the foreign industry has not been able to function. This is bad enough, but there is the additional fact which makes matters many times worse; namely, Germany is quoting to the German farmer potash at a price of $2.70 to $3.00 per unit which was formerly sold to the American farmer at 60 cents wholesale, delivered free. On this basis the American farmer will have to pay Germany seventy-five millions per annum for even that quantity of potash used ten years ago and for which he paid an annual bill of fifteen millions. Can American agriculture stand this price for an essential fertilizer ingredient and can it afford to do without?

The experimental kelp-potash plant of the U. S. Department of Agriculture. Second report: J. W. TURRENTINE. The processes under development have been brought to the point where the only potash produced now is high-grade muriate (85 per cent. KCl). This is being yielded and marketed in such quantity as to pay a very substantial part of the entire expenses, both operating and experimental, of the enterprise. By-products, bleaching carbon and iodine, are being commercial-

ised, and in the immediate future will be turned out in such quantity as to increase proceeds from sale of products to a point where all expenses will be equaled and a profit established. In the meantime other by-products of proven value, such as ammonia, are being developed and soon will be put on a commercial basis.

The reactions of coal sulfur in the coking process:[1] Alfred R. Powell. Previous work has indicated that sulfur exists in coal in three typical forms—pyrite or marcasite, sulfates and organic sulfur. A study of the changes which these forms undergo during coking has been made on a variety of coals, and the following five classes of reactions established. (1) Complete decomposition of the pyrite and marcasite to ferrous sulfide, and hydrogen sulfide. (2) Reduction of sulfates to sulfides. (3) Decomposition of the organic sulfur to form hydrogen sulfide. (4) Decomposition of a small part of the organic sulfur to form volatile organic sulfur compounds. (5) Disappearance of a portion of the ferrous sulfide and pyrrhotite, the sulfur apparently entering into combination with the carbon.

The desulfurizing action of hydrogen on coke:[2] Alfred R. Powell. A complete study has been made of the efficiency of hydrogen and gases containing hydrogen as desulfurizing agents when passed through coal in the process of coking. The effect of the hydrogen on the removal of sulfur from coke was very noticeable, in some cases nearly all of the sulfur being removed as hydrogen sulfide during a period of three hours. The ordinary sulfur coking reactions were affected in two ways by the passage of hydrogen through the coking mass: (1) the pyrite was caused to decompose at a much lower temperature, (2) the coke sulfur, which is presumably in combination with carbon, was elimination at an almost constant rate at the higher temperatures of the coking process. The size of the particles of coal did not seem to affect the rate of evolution of hydrogen sulfide. For gases containing hydrogen, the desulfurizing efficiency seemed to be proportional to the partial pressure of the hydrogen.

The analysis of sulfur forms in coal:[3] Alfred R. Powell. An investigation of the applicability to a variety of coals other than those from Illinois of the Powell and Parr method of analysis for the forms of sulfur in coal (Bul. 111, University of Illinois Engineering Experiment Station, Urbana, Ill., 1919). A complete study was made of the sulfur as it existed in the following coals—Upper Freeport, Pa., Pittsburgh seam, Pa., Pocahontas No. 3, W. Va., Letcher Co., Ky., Morgan Co., Tenn., and Cherokee Co., Kan. The method of analysis gave excellent results when applied to these coals. In the determination of pyrite, the iron-sulfur ratio checked in every case with the theoretical. After the extraction of the pyrite and sulfates, the remaining sulfur was proved to be organic in nature.

1 Published by permission of the director of the Bureau of Mines.

2 Published by permission of the director of the Bureau of Mines.

3 Published by permission of the director of the Bureau of Mines.

DIVISION OF WATER, SEWERAGE AND SANITATION

J. W. Ellms, *chairman*

W. W. Skinner, *secretary*

Sewage disposal committee of the National Research Council: Edward Bartow. This committee has been appointed to consider the many problems connected with sewage disposal and the recovery of valuable ingredients. The problems to be considered include:

1. Colloids and their effect on sewage disposal.
2. Fertilizer value of sewage sludges.
3. Content and value of grease.
4. Special processes of sewage disposal.
5. Bacteriological problems.
6. Pacific Coast problems.
7. Sewage experiment stations.
8. Primary sewage treatment including use of screens and tanks.

The committee asks the cooperation of officials, engineers, chemists, bacteriologists and others who are in charge of or connected with treatment plants or experiment stations, or who may be consultants on the design, construction or operation of such plants. Those willing to assist in the work may notify the chairman, E. Bartow, Urbana, Illinois.

Relationship of H-ion concentration of natural waters to carbon dioxide content: R. E. Greenfield and G. C. Baker. The H-ion concentration of most natural waters may be fairly accurately calculated by use of the simple mass law equation of the primary ionization of carbonic acid. Bicarbonates and free carbonic acid are determined as directed in Standard Methods of Water Analysis A.P.H.A. Bicarbonates are considered 85 per cent. ionized and the carbonic acid determination is corrected for the free carbonic acid still left in the solution at the endpoint of the titration. When the free carbonic acid is expressed in parts

per million of CO_2 and the bicarbonates in parts per million of $CaCO_3$ this equation becomes:

$$\text{H-ion Concentration} = \frac{4.0 \times 10^{-7}}{HCO_3} CO_2 + 1 \times 10^{-8}.$$

When both free carbonic acid and bicarbonates are expressed in either parts per million CO_2 or cc.CO_2 the equation becomes:

$$\text{H-ion Concentration} = \frac{3.5 \times 10^{-7}}{HCO_3} CO_2 + 1 \times 10^{-8}.$$

Preparation of ammonia-free water: G. C. Baker. Ammonia free water may be prepared by passing distilled water through permutit. This method has advantages over other methods in (*a*) ease of operation and (*b*) production of large quantities at minimum expense. Its disadvantages are (*a*) gives a water of higher mineral content and (*b*) does not remove nitrate, nitrate or albuminoid nitrogen. Indications are that American Permutits, except the especially prepared Folin Permutit will not quantitatively remove ammonia, but the English and German Permutits seem satisfactory.

Sewage treatment at Fort Myer, Virginia: J. W. Sale and W. W. Skinner. Sewage at Fort Myer is treated by settling, septicization, and aeration. The system cost about $8,000, was designed for a population of 2,000 and was used a model for plants at other cantonments. A chemical and bacteriological investigation extending over a period of six days showed that the effluent was stable and sludge inoffensive. It is believed that this type of plant warrants the consideration of small towns which contemplate installing sewage disposal systems.

The nitrate content of five hundred waters which were considered safe from a bacteriological standpoint: M. Starr Nichols. Nichols reports the nitrate nitrogen findings of 767 ground waters which were found to be safe bacteriologically. 81.7 per cent. of the waters examined had nitrate nitrogen values of between 0 and 5 parts per million, and 56.8 per cent. gave nitrate nitrogen values of between 0 and 1.0 part per million. He cites extracts and data of other investigators and points out that his work as well as do that of other workers, show that high nitrates are not a component of normal safe waters. He cites instances which show that a well may be subject to pollution and yet not be detected by bacteriological methods. The evidence indicates, so the author believes, that the nitrate determination should be made in addition to the bacteriological examination of every ground water and if found in greater quantities than 5 parts per million the source should be considered unsafe until a competent sanitary survey shows no possible source of pollution.

Seasonal variations of bacterial flora during filtration process: Harry E. Jordan. Following the operation of a water purification plant in the central states over a period of sixteen years—a series of some 50,000 examinations in a 5-year period is summarized with relation to seasonal ratios and variations by various types of organisms present. This data shows: (1) Bacterial concentration of all types studied, and the proportion of all types which are of the Coli group, is inversely proportional to the temperature. (2) Both sedimentation and filtration exercise a selective action against organisms of the Colon group and sterilization with chlorine products exercises a remarkably increased selective action against these organisms. (3) Of the total number of Coli type organisms present the fecal subtype survives purification processes—step by step—in increasingly less proportion as the temperature rises.

A study of sewage and trade wastes at Bridgeport, Conn.: W. W. Skinner and J. W. Sale. The investigation covered a period of one year and was made in cooperation with the Bureau of Fisheries in the interests of fish and shell-fish life. Dissolved oxygen data were obtained and the composition of about twenty effluents determined. Metals and acid from copper mills and waste dyes from textile mills were the chief problems given consideration. The water in the harbor is toxic to oyster larvæ. Remedial measures are contemplated.

Charles L. Parsons,
Secretary

(*To be continued*)

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.
NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, SEPTEMBER 24, 1920

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

CONSERVATION OF THE QUALITY OF WATER OF NEW YORK STATE AS A NATURAL RESOURCE

ECONOMIC VALUE OF QUALITY IN WATER

THE original abundance of water in the state of New York, its very commonness, has dulled her people's appreciation of the subtle quality value of their heritage. Momentarily shut off from their supply the cities and industries would instantly realize its vital necessity. Precipitate ruin of the wonderfully rich, living waters of the state would awaken immediate appreciation of their unreplaceable benefits. Coincident with the decreasing quality condition of the waters, grows its greater economic value. The expansion of cities with their manufactures and commerce is dependent on the very water which they threaten, and the wealth flowing from them seeks the natural wealth of the streams, and the food driven from their waters. Consider the millions spent in carrying pure water long distances to the cities, in protection of the watersheds, building and operating filtration plants, and in the disposal of sewage. Consider the millions dependent on clean water at the recreational resorts of the people. Consider the value to manufactures themselves of obtaining water of the proper quality for their processes. Consider the value of fish as unrivaled sport and unreplaceable food, and the value of shellfish industries to the state. Consider, lastly, the expense to the state in guarding these resources and in hatcheries to correct the failure of the waters. Not only may the people be denied the recreational advantages of clean waters, and the return from industries dependent on them, but they must bear the extra burden of obtaining suitable water for their vital necessities. Considering the magnitude of its trust, the state can afford to conserve its interests in the quality of water by using it to her greatest advantage.

NEW PROBLEM

The increased quantity of domestic wastes resulting from the natural growth of population does not account for the rapid deterioration in the quality of the natural waters of New York state. Sewage pollution has been anticipated; it is a time-honored problem of gradual growth; methods of treatment have been developed, and in general it is cared for by municipal disposal plants. Trade wastes, however, from the recent astonishing development of chemical industries, unnaturally supplemented by war demands, have given rise to another and more complex problem. New manufacturing plants have been built along the water courses, and the activity of older ones extended and enlarged. Little time has been left for contemplation of the damage caused by their wastes, or of preventive methods, and, unless immediate measures are taken, a great resource of the commonwealth is threatened.

QUALITY CAPACITY LIMITED

To those who have measured the amount of water with which nature endows a given area, it is obvious that the quantity is limited. Though not so concrete or commonly understood as its quantitative capacity, as for navigations and for the development of water power, its qualitative capacity for these other purposes is no less limited. The amount of contaminating material a water can absorb without injury to its various uses is strictly limited by the rate at which such substance may undergo physical or chemical change; in no other way can water escape the qualitative result of its use. This in turn depends upon the biological capacity of a stream to bring about those changes, and in this sense the waters are alive. Anything which upsets the digestive power of a stream further incapacitates it for discharging its natural functions, until such time as it may recover by increased dilution. There is a strong temptation for users of the water to ignore that fact, because the carrying power of the stream removes the offence from its source, and the natural limits are usually far exceeded before remedial action is considered. Just as in the case of development for water power, the qualitative limits of its natural capacity to be of economic value can be expanded by judicious use and scientific development.

PROPER UTILIZATION

Sufficient knowledge of the principal properties of water will enable the state to most fully utilize its proper value. It does not follow that individuals, communities, or industries, cease to return used waters to their natural drainage channels; nor is it possible by any treatment to return them unchanged. It is clearly recognized that water has a considerable dilution value within which ultimate harm is not done, and that the natural disposal capacity is one of its most fundamental and valuable assets to the state. By this is not meant the ability to carry waste away from one place to afflict another, but a truly legitimate purification function. As such it plays a great part in the economy of nature. There is constantly going on a process of regeneration of inorganic substances to organic, recharging them by the action of sunlight on green plants with the energy necessary in food for the vitality of man and other animals. From the unoxidized organic wastes of our activity must these inorganic salts be reclaimed. Nature has chosen the bacteria and other lower organisms as agents for this purpose. It is for them to prepare the nitrogen and other elements in those wastes for the next crop of vegetation. If they cease to work, these wastes would accumulate unchanged, clog the progress of the organic cycle in nature, and in a short time the earth would become a desert waste. While this activity is not restricted to the water, it particularly concerns America, whose universal adoption of the water system of sewage disposal loses a valuable fertilizer from its natural place on the land. By enriching the vegetation in the waters and furnishing abundant life thereto, it may be again returned to the people as fish and shellfish instead of beef and mutton. Such a broad consideration of conservation may not seem of immediate con-

cern in the practical use of the waters until it is realized that the same activity gives to water its disposal capacity. Without it, waste matters accumulating from the sources would render the stream unusable below. By the suitable adjustment of all factors, therefore, can its greatest benefits be derived. Only under the most exceptional circumstances are we justified in sacrificing all other uses merely to the carrying capacity of the fluid. By jealously guarding its quality and developing its useful capacity the increased burden from communities and industries can be prepared for.

INJURIES TO QUALITY VALUE

The various ways in which the quality value of water may be injured are as diverse as its many uses. Potability, where essential for public water supply, takes precedence over all other uses, and infection becomes the most dangerous injury to water. Though industrial waste seldom in itself carries infection it may in other ways by giving disagreeable odors, unpalatable taste, or objectionable color and appearance, render it unfit for drinking purposes. Furthermore, it may render purification difficult, thereby overload filtration the health of the community rests; or it may so hinder the proper functioning of sewage disposal plants as to place such a burden on the stream as to make it an impossible supply for the community. Less important, but more obvious, it is necessary for each industry to have an abundant supply of water relatively free from particular substances. For wool scouring it is lime salts; for the manufacture of fine paper it is discoloring material; and so with each industry there are some substances to be avoided. This often determines the location of an industry, and though it may be possible to treat the water in many instances, preventive measures where small concentrations entail widespread injury may be the simpler and cheaper method. There are changes in the water such as to render it unfit for boating, swimming and other recreational purposes. These effects are readily appreciated by the public, who should be anxious to support action where a public attraction becomes an open offense to public decency because some private interest wishes to monopolize a great asset for the smallest use. An enterprise which does not compensate the state for its injured interests is a deficit, and it should be the duty of conservation to prevent a selfish theft.

EFFECT ON FISH LIFE

The Conservation Commission already has been intrusted with the enforcement of laws to prevent the introduction of deleterious substances in quantities injurious to fish life. Such effect is evident where acids or poisonous wastes kill adult fish, or foreign substance may render shellfish unattractive to the consuming market. If the oxygen dissolved in the water becomes greatly diminished the fish will suffocate. Water is to fish what the ground and air combined are to land animals; it furnishes the oxygen for respiration as well as the food they eat. Organic wastes have the power to absorb the oxygen from the water and make it uninhabitable for fish life. Such an oxygen demand can be readily determined and its effect on the stream studied and predicted. Similarly those wastes which hurt the production of fish food indirectly eliminate fish from the water and its absence can not be attributed to overfishing; and anything which drives away the fish has the same effect as removing them in other ways.

Less evident, but equally important is the effect upon the development of the young, the ruin of hatching areas, and the death of the fry which may bring the efforts of the hatcheries to naught. Even though the areas of excessive pollution are localized to greater or less extent they may form pollution dams which interrupt the normal habits necessary to fish propogation. It may be possible to define the quality requirements of different areas in such a way that by artificial assistance each may be used for what it is particularly adapted, to the ultimate improvement of the whole, at the same time giving greater latitude for use of the industries.

LIMITING FACTORS

The injuries enumerated are tangible values which the water may lose. There is, however, the general value of the life in water which is so essential to its preservation for all the various uses. This life constitutes a great biologic equilibrium, delicately balancing a very complex system of factors each dependent upon the other. At any particular time a certain very small factor may determine the condition of the water. The knowledge of what biologists call limiting factors holds the greatest constructive possibilities. If this fundamental principle is thoroughly grasped, it makes evident the great significance of certain wastes under particular conditions, where a limiting factor may be involved, and it shows also the possibility to save a grave situation sometimes by a simple expedient. The most important study in the conservation of the quality of water is thus to determine the specific effect of various contaminating substances upon the limiting factors controlling the biologic equilibrium, and by eliminating them to expand the useful capacity of the streams.

PREVENTIVE METHODS

The scientific problems involved in the treatment of domestic sewage by municipalities have been largely solved. Methods are available for the intensive biologic oxidation of the organic matter so that the subsequent oxygen demand on the stream may be reduced to any prescribed requirements. The same principles may be developed for the treatment of other organic wastes from food producing industries, so that there should be no excuse for the depletion of that great essential constituent of the water. Considerable improvement can be accomplished in many cases by simple changes at little cost. Damage often occurs through thoughtlessness or carelessness, or is due to avoidable accidents. Where the attention of manufacturers has been brought to the serious consequences of such hazard they have been willing to take proper precautions and construct sufficient safety devices. The increased utilization of valuable by-products, by methods well known to industry, has gone far to remove the greatest wastes. Likewise there are corrective processes for settling out or straining out suspended matter, preventing or removing colors, tastes, odors, oil films, etc., and chemical methods for removing or rendering inocuous such deleterious dissolved substances as may work injury to the water. By the conservative application of such methods the improvement necessary to meet specified conditions can usually be attained, if not always with profit, at least without unreasonable hardship.

RESPONSIBILITY OF INDUSTRIES

The responsibility lies with the industries, who receive from the state the benefits from the waters, to study and apply the methods of treatment of their injurious wastes. This has been done in the past because of the value of many of the by-products, and in several of the more progressive concerns laboratories are constantly engaged in reclamation studies. While the possibility of returns has inspired most of these investigations, the knowledge gained leads the way to processes for the protection of the waters, and, in many cases, industries have already realized their responsibilities to the extent of adopting measures for this purpose. The great diversity and complexity of these processes make it impossible, with the limited forces at its disposal, for the state to study each individually, while the extensive chemical facilities of the plants themselves make them not only the responsible, but the logical, places to carry out much of the work. Thus will the scientific knowledge that created the damage also assume the burden of the solution of the problem of its prevention. The federal government is engaged in the study of some of the broader problems of national scope and some states have applied themselves to the solution of certain wastes in which they are particularly concerned. Where the benefits to the state justify the expense, it should be a legitimate function to study the problems which will be of general application to many industries. On the other hand, the generality of the prob-

lem of the effect of wastes upon the waters makes it a peculiarly appropriate field of study for the state and for the authority who should be the responsible judge of the requirements and standards which should apply.

POLICY OF THE COMMISSION

The Conservation Commission desires to take the broadest possible constructive attitude in approaching the problem of maintaining and developing the quality value of the water. Its relations do not bind it to any particular interest or phase of the subject to the exclusion of the others. It can avail itself of the results of the many activities working separately towards conservation of some particular quality value and, by coordinating such activities, temper their demands and supplementing them with a knowledge of changes in the water itself, develop its uses for the greatest benefit of all. The decision on all questions depends upon the particular condition and use of the water and the Commission should be able to avail itself of the best expert knowledge and testimony for sound judgment. In certain phases it will be necessary to establish new standards between those of drinking water requirements and those of common decency. That its rulings and regulations may be fair and trustworthy considerable information must be gathered and investigations prosecuted into the necessity of the measures taken. That the burden on industry or the state may be lessened, discoveries must be gleaned into the unknown possibilities of scientific development. Where prohibitive expense will be required to overcome a natural obstacle which can better be accomplished artificially by fish hatcheries or otherwise, there must the knowledge be available for the conservation of such a resource. In general, therefore, should the state interest itself in and take the action required for the development of scientific *aquiculture* that it may utilize the great water quality resources of the state.

COOPERATION WITH INDUSTRY

It should be evident that the most successful fulfillment of such a program can only be accomplished by active cooperation with the industries. The Commission welcomes, therefore, all opportunities to establish such cordial relations. It aims to become a clearing house for all available information bearing on the common problem. By associating itself with other agencies, in this and other states and the federal government working on the quality of water it can acquire the knowledge obtained by all. It will collect, classify and file for the use of all such methods and data as it may accumulate or discover. Its own investigations will aim to discover the limiting factors which operate to restrict the use of the waters, that corrective measures may be direct and economical. It will publish from time to time such information as may seem of use to the industries as well as to the public. It invites conferences, suggestions and data. In particular is it anxious to assist to the limit of its power the investigations of the industries themselves. At the present time funds are hardly adequate to carry out necessary investigations on the water, but the technical forces will be glad to consult and give any suggestions possible in carrying out such studies.

ASSISTANCE FROM INDUSTRIES

The industries, on the other hand, are in a position to render much honest assistance to the commission in the prosecution of its work. Because of limited funds it will not be possible to carry on its studies on the extensive scale which the magnitude of the problem warrants. The facilities of the various industries would help greatly to attack these problems in earnest, and the working data in their hands will greatly augment the value of the studies.

IMPORTANCE OF TECHNICAL KNOWLEDGE

The industries should be quick to appreciate the necessity of sound technical information. The efficiency upon which their dividends depend is of equal value in exploiting the resources of the water. Waste of its possibilities represents the greatest loss of all. Economy of its value depends upon elimination of what may be discovered to be unnecessary steps or in

the substitution of cheaper or more effective methods. Unintelligent operation is truly false economy, and legislation should not be left to popular caprice, but be tempered and directed by sound scientific knowledge. Especially in such a delicately balanced operation as the scientific control of the natural waters is it necessary to know the facts. Where a small factor can determine the whole condition it is necessary to be familiar with all the details. If a limiting factor can be removed by a simple expedient it allows for expansion all along the line until the next lower factor replaces it. Perhaps this, in turn, may be eliminated with slight treatment, and by successive steps in biological technology can the capacity of the stream be greatly increased with the least expenditure of effort and money.

William Firth Wells
Conservation Commission,
Albany, N. Y.

PLEISTOCENE CLAYS AS A CHRONOMETER

The Swedish expedition now in America, led by Gerard DeGeer, has an ambitious program of proposed discovery. Following are quotations from his announcement:

> . . . the undersigned described how he had, since 1878, worked out and utilized a method of determining by actual counting of certain seasonally distinct laminated clay layers, the chronology of the past 12,000 years, or the period that witnessed the evolution of man as well as of the whole fauna and flora of those parts of northern Europe and North America which during the Ice Age were barren deserts covered by extensive ice sheets, ...
>
> By the new method of investigation it has now been shown to be possible to follow, step by step, how the large ice sheets receded and melted away, this being registered from the melting season of every year by the annual deposition of melting-water sediment, and especially of seasonally laminated clays.
>
> The annual lamina from warmed years being thicker and from colder ones thinner, the chronological self-registering is at the same time a thermographical one. . . .
>
> It will thereby no doubt be possible by a kind of primary triangulation to fix at a sufficient number of points the very years when they passed by the receding ice border. By interpolation between the figures thus obtained and by help of the already mapped moraine-lines, now to be accurately dated, the laws regulating the whole recession of the great ice-sheet can certainly be established and at the same time the rate by which the rideau was pulled away from the stage of life and the amount of time during which in every region of the northern part of the New World the plants and animals have had at their disposal for their immigration and settlement; the time required for the development of the soil and the vegetable mould, for the rivers and the lakes for their erosional work, and for the evolution of our prehistoric ancestor.
>
> . . . .
>
> Still, the most far reaching result of the whole investigation might be that so rapid and at the same time so widely distributed variations of the temperature of the air scarcely can be attributed to any other cause than variations in the amount of heat reaching the earth from the sun. . . .

If that program should be promptly carried out the pleasure from scientific discovery by future students will be reduced. Truly, a yardstick of geologic time is greatly desired. More desired than needed. We know that time is long, but how long? The most common question to the geologist is "how long ago?" But if we knew the exact number of years since the ice sheet disappeared from New York, whether 31,676 or 109,322 years it might satisfy some curiosity but would make little difference in human life and race evolution. For we know that geologic time is not to be measured by human standards, and when we deal in millions of years the number of the millions has little significance. The subject appeals to the imagination, especially of the non-geologic public, and if Mr. DeGeer can find out even a part of his program he will make interesting discovery and we applaud the effort. However, lest the public should be too greatly disappointed, it is well to realize some of the difficulties in the study.

The laminated glacial clays which are the subject of measurement were deposited in deep or quiet waters facing the receding front of

the waning glacier. Evidence is found in the excessive lime content, and in the occurrence of large ice-rafted bowlders imbedded in the fine clays. Also, the clays often rest directly on smooth glaciated rock, or on the glacial drift.

The Hudson-Champlain valley is the proper line for the study, and not southern Canada, for in the stretch from New York City to the foot of Lake Champlain, some 300 miles, we have the continuous record of the removal of the Quebec (Labradorian) glacier from the United States. The St. Lawrence valley clays are subsequent in time. Of the long period of ice advance we have no record, nor of its long standstill at the Long Island-Staten Island terminal moraine. The existing record is only that of the diminishing ice sheet and the recession of its border.

The laminated clays were derived largely from the glacial outwash, being the rockflour from the glacial mill. Partly they came from the land wash, by streams eroding the freshly uncovered glacial drift. At the time the clays were deposited the glaciated territory was much lower than to-day, having been depressed by the long-continued weight of the deep ice cap. With the lifting of the burden the land slowly rose. With the land rise the tidal currents and river flow in the shallowing waters swept away most of the clay deposits, or buried them along the sides of the valley under sand and gravel beds. The clays remaining and open to examination are only scattered and minor fragments of the original more or less continuous deposits. These remnants are found along the sides of the valleys; the bulk of the beds which occupied the prisms of the valleys has gone out to the sea.

In the Hudson we have no considerable beds south of Tappan Sea and Haverstraw Bay, although some clays in New Jersey may represent the early time. In the narrow stretch above Peekskill erosion has removed most of the clay, but we find good remnants in the wider valley of the Newburg district. Northward the next massive clays are at Kingston, with only small remnants beyond. In the Albany district and northward the sealevel waters were wide but shallow, and silt and sand plains laid down. In the deeper Champlain Valley massive clays were laid, not only in the broad basin but also in the valleys of tributary streams.

A similar history pertains to the Connecticut Valley and to every deep valley in New England and the maritime provinces having a deep estuary.

The lamination of the clays was produced by interrupted deposition, or variation in the rate of deposit. In the Lower Hudson and in the St. Lawrence the oceanic tides were a periodic factor. In the upper beds of any district the stream inwash of severe storms was an irregular factor. The periodic element on which emphasis is placed is the seasonal variation of the glacial outwash, due to differences of summer and winter melting. In non-tidal areas this may doubtless be discriminated from the superposed day and night variation; and from tidal variation in the open estuary districts. The irregular storm factor may not be a serious complication.

As a time record the clays must be regarded as overlapping, south to north, or as constituting a theoretical vertical column, the southern beds at the bottom of the column and the northern beds at the top. It becomes necessary, therefore, to correlate the laminæ; that is, to determine which particular series of laminæ in a southward section is identical in time with some lower laminæ in a northward section, so as to eliminate duplication. With the fragmentary character of the Hudson-Champlain beds it would seem impossible to identify horizons. And correlation of far separated localities with the indefinite moraine lines will be extremely difficult in either the Hudson-Champlain or the St. Lawrence valley.

DeGeer's estimate of Postglacial time as 20,000 years is certainly an underestimate for America. It should be understood that the ice sheet did not diminish steadily, or the front back away continuously. The ice margin had many oscillations, readvances and reretreats, each probably covering many thousands of years. In the Mississippi Valley between Cincinnati and Mackinac F. B. Taylor has mapped fifteen frontal moraines, each of which

is believed to represent readvance, or at least a long pause in the ice front. For these somewhat regular oscillations no secular cause appears adequate except the precision of the equinoxes, and Taylor figures the time, using the minimum of the precession periods, as 75,000 to 150,000 years. In New York we have many clear proofs of the great length of Glacial and Postglacial time. One of them refers to continental land uplift. Since the glacier passed off from New York the land at the north boundary has risen 740 feet, and that rise is all subsequent to the deposition of the Hudson-Champlain clays, though not to that of the clays of the St. Lawrence.

Any measurement of time by counting seasonal lamination of the Pleistocene clays will require conscientious study of many sections, with the same scrupulous care that Huntington gave to the counting of the growth rings in the California Big Trees.

The clay record, it should be repeated, is only the time while the latest ice sheet was passing off, and that time is only a fraction of glacial time, to say nothing of true Postglacial time.

It is apparent that the proposed study can not be done hurriedly, by reconnaissance and cursory methods. It is the work of a lifetime, and when done is little more than a guess. Possibly such study might develop criteria and methods that would give precision.

To attribute the long-period variation in world climate which produced the Pleistocene Glacial Period, and other vastly more ancient glaciation, to variability in solar radiation is the easiest way of explaining a difficulty. It has no scientific basis. We would better seek causes for climatic changes in the known geologic and atmospheric changes. For this Professor Chamberlin has blazed the path.

H. L. FAIRCHILD

UNIVERSITY OF ROCHESTER

GENERAL RESOLUTIONS OF THE PAN-PACIFIC SCIENTIFIC CONFERENCE[1]

1. FUTURE CONFERENCES

SINCE the present conference has been found highly inspiring and illuminating and an invaluable aid in defining the essential problems of the Pacific region, be it

Resolved that future similar conferences should be held at intervals of not over three years.

2. PERMANENT ORGANIZATION

The results of the First Pan-Pacific Conference have demonstrated the high value of meetings for the discussion of problems common to all countries whose interests lie wholly or in part within the Pacific area; and have shown that the problems relating to the welfare of Pacific peoples are too large and too complex to be solved satisfactorily except by sympathetic cooperation of individual institutions and governmental agencies. To develop a unity of interest and to make harmonious coordination practicable, it seems desirable that some permanent organization be established which may serve as the point of contact for representatives of various interests in the countries of the Pacific. Be it therefore

Resolved that the attention of the governor of Hawaii be called to the great opportunity afforded by an organization designed for the advancement of the common interests of the Pacific, including scientific research, and to the desirability of taking action which may lead to the development of such an organization vouched for and supported by the various Pacific countries.

3. INTERNATIONAL RESEARCH COUNCIL

Since this conference commends the organization of the International Research Council as a means toward coordinating research in science; be it

Resolved that it is the desire of this conference that any agency created for the guidance of scientific research and exploration in the Pacific region may be affiliated with the council and with the various national research councils of the nations of the Pacific.

4. SHIPS FOR EXPLORATION

The cost of scientific researches in the Pacific which involve the continuous use of a ship is prohibitive for most scientific institutions and individuals. The results of the *Challenger* and the *Wilkes* expeditions have

[1] Held at Honolulu, August 2 to 20, 1920.

demonstrated the great advantage gained by the use of government-owned ships for scientific exploration. Be it therefore,

Resolved that this conference unites in inviting the attention of governments to the desirability of providing vessels for suitably planned expeditions.

5. PROMOTION OF EDUCATION

The results of scientific research have led to extensions of human knowledge and to increased control of the forces and resources of nature the values of which can not be measured. All scientific work which is well done is of value, and no man can predict to what useful purposes the results of any investigation, no matter how recondite, may be put. It is of fundamental importance that sufficient numbers of young men and women of first class ability shall be adequately trained, and that teachers and investigators shall be properly compensated. This conference therefore, *Recommends:*

1. That in order that young men may enter upon scientific careers without sacrificing all hope of reasonable financial returns, the compensation for instruction and for research in science be increased so that all can at least be assured of a comfortable living for themselves and their families, and that men of exceptional attainments may receive financial rewards which shall approximate those which their powers could command if directed to commercial ends.

2 That persistent efforts be made to inform the public of the progress of science and of its bearings upon the practical affairs of life.

3. That to enlarge the experience and vision of the instructors in the various colleges and universities of the Pacific countries, making them thereby more competent and inspiring teachers, the exchange of teachers between institutions in different countries to be encouraged and made possible.

4. That a clearing house of information relative to opportunities for scientific study and research in the Pacific area be established.

5. That arrangements be perfected between the universities and other research institutions whereby properly qualified students may move from institution to institution carrying on their work at the place or places where the best facilities are available for the special kind of work upon which each may be engaged.

6. That a considerable number of fellowships be provided, with adequate stipends which shall be looked upon as compensation for the faithful performance of scientific work, and that especially able work by young investigators be rewarded by substantial prizes.

7. That to stimulate interest in the Pacific and inculcate a knowledge of its importance and unity, text-books should be prepared in which proper emphasis will be placed upon the Pacific area, its physical features, peoples, fauna, flora, resources and trade, and that the schools in Pacific countries be encouraged to give instruction which will stimulate the interest and enthusiasm of young students in the objects of their environment.

SCIENTIFIC EVENTS

DIMENSIONS AND AREA OF THE UNITED STATES

THE gross area of the United States is 3,026,789 square miles. The land area amounts to 2,973,774 square miles, and the water area—exclusive of the area in the Great Lakes, the Atlantic, the Pacific, and the Gulf of Mexico within the three mile limit—amounts to 53,015 square miles. These and other data determined or compiled by the United States Geological Survey, Department of the Interior, to show the limits of the continental United States contain some interesting facts.

The southern most point of the mainland is Cape Sable, Fla., which is in latitude 25° 07′ and longitude 81° 05′. The extreme southern point of Texas is in latitude 25° 50′, and longitude 97° 24′. Cape Sable is therefore 49 miles farther south than the most southern point in Texas.

A small detached land area of northern Minnesota at longitude 95° 09′ extends northward to a latitude 49° 23′.

The easternmost point of the United States is West Quoddy Head, near Eastport, Maine,

in longitude 66° 57′ and latitude 44° 49′; the westernmost point is Cape Alva, Wash., in latitude 48° 10′, which extends into the Pacific Ocean to longitude 124° 45′.

From the southernmost point in Texas due north to the forty-ninth parallel, the boundary between the United States and Canada, the distance is 1,598 miles. From West Quoddy Head due west to the Pacific Ocean the distance is 2,807 miles. The shortest distance from the Atlantic to the Pacific across the United States is between points near Charleston, S. C., and San Diego, Calif., and is 1,152 miles.

The length of the Canadian boundary line from the Atlantic to the Pacific is 3,898 miles. The length of the Mexican boundary from the Gulf to the Pacific is 1,744 miles. The length of the Atlantic coast line is 5,560 miles and that of the Pacific coast line is 2,730 miles. The Gulf of Mexico borders the United States for 3.640 miles.

Nearly all maps of the United States show the parallels of latitude as curved lines and are likely to lead the ordinary observer to believe that certain eastern or western states are farther north than some of the central states that are actually in the same latitude. For this reason, one who is asked which extends farther south, Florida or Texas, is very likely to say "Texas," but, as stated, the mainland of Florida is nearly 50 miles farther south than the southernmost point in Texas. For the same reason, when we consider the geographical positions of countries south of the United States we find that errors are likely to be made in estimating position or extent in longitude. Few realize that the island of Cuba, for example, if transposed directly north would extend from New York City to Indiana, or that Habana is farther west than Cleveland, Ohio, or that the Panama Canal is due south of Pittsburgh, Pa., or that Nome, Alaska, is farther west than Hawaii.

THE BRITISH DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

The following is a list of Research Associations which have been approved by the department as complying with the conditions laid down in the government scheme for the encouragement of industrial research and have received licenses from the Board of Trade:

The British Boot, Shoe and Allied Trades Research Association, Technical School, Abington Square, Northampton. *Secretary*—Mr. John Blakeman, M.A., M.Sc.

The Brittish Cotton Industry Research Association, 108, Deansgate, Manchester. *Secretary*—Miss B. Thomas.

The British Empire Sugar Research Association, Evelyn House, 62, Oxford Street, London, W.1. *Secretary*—Mr. W. H. Giffard.

The British Iron Manufacturers' Research Association, Atlantic Chambers, Brazennose Street, Manchester. *Secretary*—Mr. H. S. Knowles.

The Research Association of British Motor and Allied Manufacturers, 39, St. James's Street, London, S.W.1. *Secretary*—Mr. Horace Wyatt.

The British Photographic Research Association, Sicilian House, Southampton Row, London, W.C.1. *Secretary*—Mr. Arthur C. Brookes.

The British Portland Cement Research Association, 6, Lloyd's Avenue, London, E.C.3. *Secretary*—Mr. S. G. S. Panisset, A.C.G.I., F.C.S.

The British Research Association for the Woollen and Worsted Industries, Bond Place Chambers, Leeds. *Secretary*—Mr. Arnold Frobisher, B.Sc.

The British Scientific Instrument Research Association, 26, Russell Square, W.C.1. *Secretary*—Mr. J. W. Williamson, B.Sc.

The Research Association of British Rubber and Tyre Manufacturers, c/o Messrs. W. B. Peat & Co., 11, Ironmonger Lane, E.C.2.

The Linen Industry Research Association, 3 Bedford Street, Belfast. *Secretary*—Miss M. Burton.

The Glass Research Association, 50, Bedford Square, W.C.2. *Secretary*—Mr. E. Quine, M.Sc.

The British Association of Research for Cocoa, Chocolate, Sugar Confectionery, and Jam Trades, 9, Queen Street Place, E.C.4. *Secretary*—Mr. R. M. Leonard.

THE CENTENARY OF OERSTED'S DISCOVERY[1]

On August 31 and September 1 the centenary of the discovery of electromagnetic action by the Danish physicist, Hans Christian Oersted, was celebrated at Copenhagen. Meetings were held in the Town Hall and

[1] From *Nature*.

university, at which many Scandinavian men of science were present, and the occasion was marked by the publication of some of Oersted's scientific correspondence. It was during the winter of 1819–20 that Oersted observed that a wire uniting the ends of a voltaic battery affected a magnet placed in its vicinity, and after prosecuting his inquiries some months longer, in July, 1820, he published his Latin tract, "Experimenta circa effectum Conflictus Electrici in Acum Magneticum." The importance of his discovery received instant recognition. Ampère, Arago and Davy all seized on the idea, and four months after the publication of his tract Oersted was elected a foreign member of the Royal Society and awarded the Copley medal. Efforts to connect magnetism with electricity had hitherto met with little success, and Wollaston, in his discourse as president of the Royal Society, referring to Oersted's discovery, expressed the hope that "the gleam of light which thus beams upon us may be the dawn of a new day, in which the clouds which have hitherto veiled from our sight the hidden mysteries of light and heat, of electricity and magnetism, may be dispelled." Oersted, who was the son of a country apothecary, originally studied medicine, but turning his attention to chemistry and physics while at Copenhagen University, and he held that position until his death in March, 1851, at the age of seventy-three. Known alike for his genial and kindly nature and for his scientific labors, he was the author of some two hundred memoirs, and received many honors at home and abroad. Twenty-five years after his death a bronze statue of him was erected on the old fortification of Copenhagen.

THE NATIONAL COMMITTEE ON MATHEMATICAL REQUIREMENTS

THE National Committee on Mathematical Requirements held a meeting at Lake Delavan, Wisconsin, on September 2, 3 and 4, at which a number of reports were discussed and adopted. A report on The Revision of College Entrance Requirements received the greatest amount of discussion. It is hoped that this report may be released for publication early in October. It includes a general discussion of the present problems connected with college entrance requirements in mathematics, a report of an investigation recently made by the National Committee concerning the value of the various topics in elementary algebra as preparation for the elementary college courses in other subjects and a suggested revision of the definitions of entrance units in elementary algebra and plane geometry. A copy will be sent to any person interested upon application to the chairman of the committee, Professor J. W. Young, Hanover, N. H.

A preliminary draft on mathematics in experimental schools was discussed at this meeting. Mr. Raleigh Schorling of the Committee has spent over a year collecting material for this report. Miss Vevia Blair of the committee presented her report on the present status of disciplinary values in education. It is expected that this report also will be released for publication in October. It gives a critical review of the complete literature concerning the experimental work on the transfer of training.

Professor E. R. Hedrick presented a report which he prepared at the request of the National Committee on "The Function Concept in Secondary School Mathematics." This report also will be published in the near future.

A preliminary report on junior high school mathematics is in the press of the U. S. Bureau of Education and should be ready for distribution early in October. A subcommittee under the chairmanship of Professor C. N. Moore in preparing a report on "Elective courses in mathematics in secondary schools." A committee under the chairmanship of Professor David Eugene Smith is preparing a report on "The standardization of terminology and symbolism" and Professor R. C. Archibald is preparing one on "The training of teachers." It is expected that all three of these reports will be presented for the consideration of the national committee in October.

SCIENTIFIC NOTES AND NEWS

THE First Pan-Pacific Scientific Conference closed its three weeks session at Honolulu on August 20. Delegates were present from Australia, Canada, China, Japan, New Zealand, Peru, the Philippines, Samoa and from several scientific organizations and Federal Bureaus of the United States. The proceedings of the conference are to be published by the Bishop Museum under the direction of a committee consisting of Dr. Arthur L. Dean, president of the University of Hawaii, Dr. Herbert E. Gregory, Yale University, Dr. T. Wayland Vaughan, United States Geological Survey and Dr. Henry S. Washington, Geophysical Laboratory. This committee announces that the daily proceedings of the conference, including the discussions and the resolutions adopted, will be issued shortly and that the detailed programs of research in various branches of science will appear early in 1921.

DR. CHARLES MACFIE CAMPBELL, assistant director of the Henry Phipps Psychiatric Clinic, Johns Hopkins Hospital, has resigned to become professor of psychiatry at Harvard Medical School and director of the Boston Psychopathic Hospital. Dr. Campbell will assume his new work on October 1.

DR. OLIVER KAMM, of the chemistry department of the University of Illinois, has been appointed director of the Chemical Research Department of Parke, Davis & Co.

DR. C. D. SHERBAKOFF, hitherto truck pathologist at the Florida Agricultural Experiment Station, Gainesville, has accepted the position of station pathologist at the Tennessee Agricultural Experiment Station, Knoxville.

UNIVERSITY AND EDUCATIONAL NEWS

DR. HARRY BEAL TORREY has resigned from the faculty of Reed College to become professor of zoology and director of fundamental education in medical science in the University of Oregon. He will divide his time between Eugene and the School of Medicine in Portland. An attempt will be made to bring together in one course the premedical and medical years and to obliterate the divisions commonly existing between premedical, preclinical and clinical studies.

AT Tulane University the following appointments have been made: Dr. D. S. Elliott, head of the department of physics in the Georgia Institute of Technology, professor of physics; Dr. S. A. Mahood, chemist of the Forest Products Laboratory of the University of Wisconsin, associate professor of chemistry, and Dr. Herbert E. Buchanan, professor of mathematics in the University of Tennessee, professor of mathematics.

DR. LANE has been appointed clinical professor of dermatology in the Yale Medical School and Dr. Alfred G. Nadler has accepted a similar position These two physicians will divide between them the work heretofore carried on by Dr. Ralph A. McDonnell, resigned.

DR. C. MCLEAN FREASER has been appointed professor of zoology in the University of British Columbia, at Vancouver.

THE chair of chemistry in Berlin University, rendered vacant by the death of Emil Fischer, will be filled by Professor Fritz Haber, who will retain also his present position of director of the Emperor William Institute for Physical and Electro-Chemistry.

DISCUSSION AND CORRESPONDENCE

MIRAGES?

TO THE EDITOR OF SCIENCE: I have frequently observed the phenomenon described by F. W. McNair in SCIENCE for August 27. Contrary to the assumption of Mr. McNair, however, it may be observed under any conditions of weather and temperature. I have seen it ahead many times while driving an automobile over concrete and tar-surfaced roads. There can be little doubt that it is a phenomenon of simple reflection and is therefore entirely independent of atmospheric conditions. Any compara-

tively rough surface seems to act as a polished mirror toward light striking it at a very small angle of incidence. The mirage on the plains, being a phenomenon of refraction, is of an entirely different nature.

H. H. Platt

To the Editor of Science: In his communication to the issue of August 27, Mr. F. W. McNair touches upon a matter which seems to me worthy of further consideration.

In the course of numerous trips about the country by automobile, I have had repeated occasion to note the sort of mirage mentioned, particularly on stretches of surfaced road. The phenomenon commonly takes the form of an apparent small pool of water, which appears suddenly a little way ahead, and disappears with equal suddenness.

In most cases the reflecting air-surface would appear to be only a few inches above the road: the effect is that of a shallow pool, and one involuntarily dodges the apparent depression. On one or two occasions, however, I have noted a reflecting surface high enough to cut off the wheels of a vehicle driven through the lower stratum of air.

It occurs to me that the condition suggested may serve in part to account for ideas of temporary disappearance, or dematerialization, of solid objects, and for occasional accounts of apparent hallucination.

This matter would seem to be interesting and important enough to warrant fuller discussion.

Freeman F. Burr

Rattlesnake Island, past which Perry sailed his fleet to the battle of Lake Erie in 1813, lies two miles northwest of Put-in-Bay and occupies about eighteen degrees of the horizon.

On Sunday, July 18, at about one o'clock, while watching a thunderstorm approach over Rattlesnake, a second island was seen, somewhat higher than the real one and shifted to the westward approximately one third the apparent length of the island.

At first this was thought to be a mirage of Middle Sister which lies some miles to the northwest. Two small islets, the Rattles, which lie off shore from the western end of Rattlesnake and which were projected to the left of the phantom island, indicated, however, that we were looking at an image of Rattlesnake.

The apparition was seen from a cottage three hundred yards to the southwest as well as from the laboratory cottage. It persisted for some time, possibly as long as fifteen minutes, disappearing just before the sheets of rain from the storm blotted out Rattlesnake entirely. The outline of the real island was at all times more distinct than that of the image, which was—or seemed to be—slightly behind it as well as above.

Stephen R. Williams
Lake Laboratory,
Ohio State University,
Put-in-Bay, Ohio

FAMILY AND SUBFAMILY NAMES IN ZOOLOGY

To the Editor of Science: I have read with much interest Oberholser's thirteen rules for family and subfamily names appearing in the issue of Science of August 13, 1920, which he says have the approval, in part at least, of thirteen named persons well known for their work in systematic zoology. If Dr. Oberholser had stopped with number 12 his rules would appear to be quite ideal.

Why rule 13? Two family or subfamily names having the same spelling are comparatively rare. They are for the most part going to be used by persons who know what the type genera are. It is quite inconceivable that there would ever be any real confusion because of identical spellings. If it is desirable to distinguish between two families or subfamilies that would be spelled alike by following rules 1 and 2, a prefixed *Pro* seems to me to be the least desirable method. Any one not familiar with the case would naturally think the type genus of *Propicidæ* to be either *Propicus* or *Propica*. In Palmer's "Index Generum Mammalium" there are over 100 generic or subgeneric names beginning with the prefix *Pro* and at least half a dozen of these names are used in forming family or subfamily names.

The simplest method to distinguish between two family or subfamily names that would otherwise be spelled alike, would seem to be to add *idæ* or *inæ* to the full generic names in the few cases in which duplication would occur, as *Picaidæ and Picusidæ*. Other expedients would be to write *2d* after the later name, or the year in which the name was published, or the Greek letter β. To make a prefix as *Pro* a part of the family or subfamily name and so cause the name to appear in alphabetic lists far away from its logical place and to lead the uninitiated into thinking of a *Pro* genus which does not exist seems as absurd as it is unnecessary.

M. W. LYON, JR.

THE NEEDS OF MEN OF SCIENCE IN RUMANIA

TO THE EDITOR OF SCIENCE: Please publish in SCIENCE the following extract from a letter of Professor Marinesco, a leading scientist and physician in Rumania.

. . . . I believe that our American colleagues, whose country made such a noble contribution to victory, ought to take notice of the unhappy state of the Rumanian men of science which is due to the occupation of our country by the enemy. It is probably unknown that after the occupation we were in extreme distress, because all our instruments were then taken away or destroyed. A part of our libraries has been destroyed. Furthermore, since Rumania has no chemical industries, we do not possess the chemical reagents, etc., indispensable for scientific research. Allied European countries which would aid us, France for instance, have been equally devastated.

Perhaps the United States which has contributed so largely to the restoration of Europe would make a grand gesture and help the investigators of our country by sending some instruments and a certain amount of reagents as far as they are able to do so. They can not be accepted gratuitously; but we believe that we will be able to repay the debt later when the unfavorable exchange no longer weighs so heavily upon our laboratory budgets.

Hoping that my prayer will find a favorable response among my American colleagues, we would like you to be our spokesman.

S. J. MELTZER

ROCKEFELLER INSTITUTE, NEW YORK,
September 1, 1920

QUOTATIONS

SCIENCE AND THE PUBLIC

THIS is the heading of a leaderette in the *Daily Mail,* which states that "Light is to be 'caught bending' next week at Cardiff." It goes on to say that "We have in Britain today as original a group of scientific men as any country in the world; and they are beginning at last to see the wisdom of coming out of their caves and laboratories and applying their brains to practical affairs; to the laws that govern heredity, to wireless apparatus, to the uses of alcohol, to the migration of fish, to medicinal thought-reading, to the possibilities of intensive cultivation—which bulks largely this year—indeed to scores of practical themes to which their more abstract studies are leading.

"In any case, it is time most profitably spent if for one week in the year our men of science bend their united energies to the work of interesting the public in the advance of science. It is as much the duty of the public to appreciate the men of science as of men of science to come to meet the public."

Now, what does the *Daily Mail* think "our men of science" had been doing during the period before they began to see the wisdom of coming out of their caves and applying their brains to practical affairs? Does it really think that they have suddenly awakened and hurriedly worked up papers on the laws of heredity, on wireless apparatus, etc., just for the purpose of interesting the public during this British Association week?

The *Mail* speaks of "our men of science" with a patronizing air, a kindly condescension which implies that they are rather weird uncanny folk, not quite normal, who dwell in "caves and laboratories," and do not usually apply their brains to practical affairs—so unlike the brainy trumpeters of the daily press, who gaily talk of "catching light bending" without having the faintest conception of the significance of the allusion. This superior attitude of the journalist who, in many cases, can not even write English correctly, and whose mind is blankly opaque to the most elementary notions of physical science, is galling to those

who are able to appreciate the nature and value of the work of that band of British scientific heroes, without whose efforts, the result of long years of patient training in research, the war would inevitably have been lost, on the land, on the sea, and in the air. If the lay press would descend from its wooden pedestal and inculcate in the public mind that knowledge and love of science through which "our men of science"—unexcelled in the whole world—acquired their equipment for winning the war, instead of perpetuating the silly and antiquated notion that they are habitually immersed in useless hobbies of no practical utility, it would do real service to the country.—The London *Electrical Review*.

NOTES ON METEOROLOGY AND CLIMATOLOGY

TORNADOES

A FEW weeks ago an official of the Weather Bureau was asked this question: How many tornadoes will a healthy cyclone hatch in a day? This, naturally, was a difficult question to answer; but it must be admitted that the tornadoes of March 28, in the middle western and southern states, and those of April 20 in Mississippi, Alabama and Tennessee, afford striking examples of the fecundity of barometric depressions when other conditions are favorable. The *Monthly Weather Review*[1] for April, 1920, contains about 18 papers, discussions, and notes concerning these very destructive tornadoes, as well as those which occurred in North Carolina and Oklahoma on April 12 and May 2, respectively.

Eleven of the thirteen tornadoes of March 28 occurred in the region surrounding lower Lake Michigan and two occurred in western Alabama and eastern Georgia. It appears that they were associated with the passage of the squall front or line of wind-convergence which marked the barrier, in the southeastern quadrant of the deep "low," between southeasterly and southwesterly winds. The "low" which gave rise to this wind-shift line moved from east-central Nebraska to northern Wisconsin in the course of the day. In the region of lower Lake Michigan, it was possible to trace the hourly progress of the line as it advanced on a slightly curved front in a general east-northeasterly direction. It appeared at 6 A.M. in northeastern Missouri and southeastern Iowa; at noon, it extended along the eastern line of Illinois northward to the lake, thence curving northwestward into Wisconsin; at 9 P.M., it had almost reached Lake Huron, and was over the western end of lake Erie. As its northern end reached Lake Michigan, there was a perceptible forward bulge which may be attributed to the decreased friction as the wind advanced over the smooth water surface.

Regarding the circumstances under which these tornadoes were formed, Dr. Charles F. Brooks, in his discussion, says:

> Why did these 13 tornadoes occur on the afternoon of March 28? Let us review the facts as brought out by the weather observations:
>
> 1. There were strong, unusually warm winds from the southeast and south-southeast over a large area from the Gulf of Mexico to the Great Lakes.
>
> 2. A well-marked line . . . separated these winds from still stronger, but slightly cooler southwest or south-southwest winds in a belt immediately to the west.
>
> 3. Heavy thunderstorms, some with tornadoes and hail, occurred along this line of converging winds.
>
> 4. Immediately to the west of the northern portion of this line was a belt of diverging winds, characterized by brilliantly clear skies and exceedingly dry air, the driest on record at some stations. . . .
>
> 5. Kite observations indicated the presence of a cold southwest-west wind at a moderate height overrunning the warm surface wind.
>
> 6. The northeasterly movement of the tornados and lower clouds and the fall of hail on or to the east of the tornado paths indicated a southwest to, at least, west-southwest wind not far aloft.
>
> Surely this was an unusual set of conditions. With winds meeting at an angle of about 60° and at a rate of about 30 miles an hour, large volumes of air were sent upward and given a counter-clockwise rotary motion by the thrusts of the southwest squalls routing under the rear portions of the

[1] Papers on tornadoes, pp. 191–213. Reprints of these papers may be obtained upon application to the Chief, United States Weather Bureau, Washington, D. C.

slower north-northwestward-moving masses of warmer air. At a moderate height condensation took place in the moist, upthrust air, and as it ascended at a lesser rate of cooling, due to the liberation of the latent heat of condensation, it probably was squeezed aloft at an increased rate by the cold wind it was probably encountering. Under such conditions intense vertical movement accompanied by a rotary motion of small dimensions makes a tornado.

The circumstances surrounding the formation of the tornadoes of April 20 were somewhat different. In this case, there was a long, oval-shaped low pressure area over the southern part of the Mississippi valley. The storms occurred in the morning at a time when the line of wind-convergence was a considerable distance to the west of the line of tornado formation. Therefore, it can not be said, as in the previous case, that the mechanical effect of the wind-shift line was operative. There is another striking feature: All of these whirls were formed along a north-south line which lay about 30 miles west of the Mississippi-Alabama line. The first occurred at Ingomar at 7:30 and followed a northeasterly course into Tennessee where it continued by a series of dips almost to the center of the state. The second began about 40 miles south of the first, near Bradley at 8:00 A.M. and moved northeastward, disappearing in northcentral Alabama. The third began near New Deemer, at 8:30 A.M. and ended near Brownsboro, Alabama. (This was the longest of the four paths, and was marked by an almost continuous swath of destruction for 150 miles.) The fourth appeared at Bay Springs at 9:55 and ended near the state line east of Meridian, having passed within a mile of the Weather Bureau office at that place. The significant facts are, (1) that these tornadoes formed on a nearly north-south line, and (2) that they formed at almost equal intervals of time and distance. The probable explanation is that these formations resulted when an overrunning layer of cold air arrived over a given place, where other conditions were favorable, increasing the vertical temperature gradient to such a degree that there was immediate and intense convection. That this advancing front was probably coming from the northwest is shown by joining the positions of the tornadoes at any given time. The resulting line is normal to the wind direction supposed to exist aloft.

According to Mr. J. H. Jaqua, the Weather Bureau meteorologist at Meridian, Mississippi, the passage of the tornado at that place was accompanied by almost total darkness. He says:

> . . . The darkness between 10:30 and 10:39 A.M. was as intense as would be common for a cloudy moonless night at 9:30 or later, and though lights were on in the business houses (but no street lights were in operation), pedestrians could distinguish each other only with great difficulty. . . . The pall of darkness was so unnatural that it was extremely weird. . . .

No account of tornadoes is complete without the recital of some of the many "freaks" which such storms are wont to perform. The removal of feathers from chickens, the complete destruction of houses, the clean sweeping through deep forests, and the carrying of objects great distances, are examples frequently recounted. Of the many curious pranks of these storms, however, there are some which are worthy of mention. Here are some excerpts from the numerous accounts in the article cited above:

> An automobile locked in a garage was undamaged, although the garage was blown to splinters.
>
> Half a dozen glass jars of fruit were carried 100 yards by the winds and not damaged. (*Bay Springs, Miss.*)
>
> A car load of stone was whipped about like a feather, and trees, one especially large oak, were twisted from the roots as if they had been bits of wire. (*Florence, Ala.*)
>
> There seemed to be two puffs of wind; one carried things toward the west. In about a quarter of a minute everything came back. I tried to keep my family down on the floor. One of my boys blew out of the house; then blew back. . . . (*From report of J. P. Sanderson, Newburg, Ala.*)
>
> [The tornado] swept rapidly across the cove, . . . as it neared the mountain range and went over it, leaving a path clear of any standing timber, houses, or fences. In going over the path of

the storm the next day . . . cedar trees, with trunks 16 inches through [were found] lying on the upper benches of the mountain, that had been torn up by the roots down in the valley and brought up bodily and deposited among the big timber on top of the range. . . . (*Postmaster Okal, Huntsville, Ala.*)

. . . A mule was hurled 100 feet against a tree stump, its body pierced by a 2 by 4 scantling; a horse was carried several hundred feet into a patch of wood where it was found the following morning apparently unhurt; a steel range from the Preston home was found 3 miles away in a wheatfield; harrows, plows and other agricultural implements were scattered over the -fields for miles around; a sewing machine was found hanging from a tree limb. . . . (*Occurred in the tornado of April 12, in Union County, N. C., according to Mr. G. S. Lindgren.*)

This list could be continued indefinitely, and it is presumed that each locality visited could yield a number of remarkable "freaks."

The series of articles in the *Review* is concluded by a reprint from the "Physics of the Air,"[2] by Dr. W. J. Humphreys on the "Tornado and its cause," and a bibliography prepared by Professor C. F. Talman, which gives the principal publications containing statistics of tornadoes in the United States.

It is needless to say that the twenty-one or more tornadoes which have been experienced in the United States this spring, have been terribly destructive of life and property. It is estimated that in the tornadoes of March 28 killed 163, injured several hundred and destroyed ten million dollars worth of property. Those of April 20 were even more destructive of life, there being 229 deaths reported and over 700 injured, with a property loss also extending into the millions. This most destructive of storms is so extremely local that even though there may be a wind speed of between two and five hundred miles per hour in the funnel-cloud, this speed falls off so rapidly with distance from the center that the wind may not even be of destructive violence within a few hundred yards. Owing to this extreme localization, the tornado can not be accurately forecast; and if it could, it is so violent that no precautions could be taken except these already observed in localities where it frequently occurs—namely, keeping in readiness the storm-cave.

[2] *Journal of the Franklin Institute*, January, 1918, pp. 114–116.

C. LEROY MEISINGER
WASHINGTON, D. C.

SPECIAL ARTICLES

THE SOUNDS OF SPLASHES

UNDER the above title an interesting note has just been published by Professor C. V. Raman and Mr. Ashutosh Dey.[1] The authors call attention in a footnote to the fact "that the splash of a liquid drop is practically soundless unless the height of fall exceeds a certain minimum." In connection with this remark it seems perhaps worth while to publish a note on a preliminary study of a similar problem which I made in 1915. I have been intending to return to the work, but have been giving my attention to other matters.

My observations were confined to drops of water falling into water, and were made by ear. They indicate not only a single minimum height of fall within which the drops strike the water silently, but also other greater heights of fall for which the drops enter the water without sound. The boundary between a region in which a drop makes a sound when it strikes and a region in which it does not make a sound when it strikes is very sharp, a fraction of a millimeter difference in the height of fall being sufficient to pass from a drop which falls silently to one which makes a sharp click when it strikes.

In the figure the results of five experiments are shown. The numbers at the left give the distances in centimeters from the orifice from which the drop fell to the surface of the water below. Each vertical line indicates a range throughout which the drops click when they strike the water. The maximum heights of fall tried are indicated by the horizontal dotted lines.

It will be seen that in most cases a drop strikes silently if it falls less than about 5.5 cm., if it falls more than about 7 cm. but less

[1] *Phil. Mag.* (6), 39, p. 145, January, 1920.

than 8 cm., or if it falls more than 11 cm. With increasing size of drop all of these distances increase. Thus the lower limit of the range of sounding which is marked *A* on the figure is about 7.0 cm. for a drop which has a mass of 45 mg., but is between 7.7 cm. and 7.8 cm. for a drop which has a mass of 49 mg.

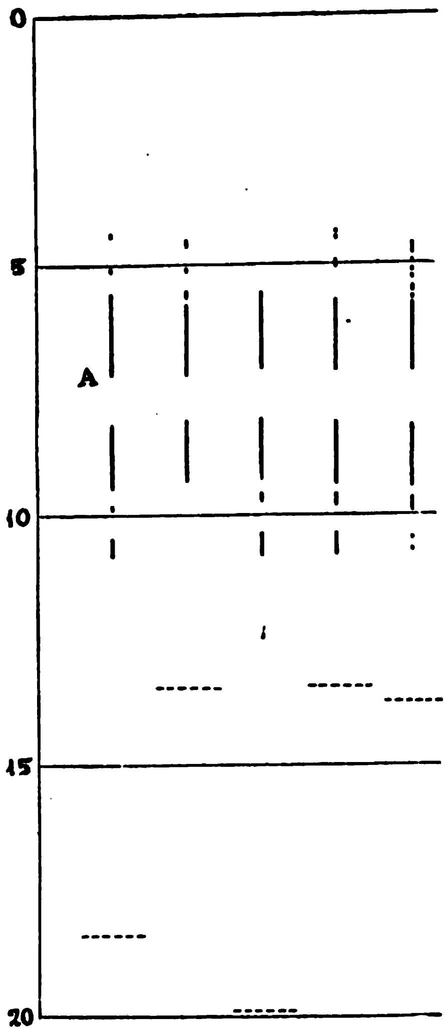


FIG. 1.

The depth of the water into which the drop falls makes no difference so long as this depth exceeds about three centimeters. The horizontal distance from the boundary of the water surface to the point at which the drop strikes makes no difference so long as this distance is more than about a centimeter. The depth of the water surface below the top of the containing vessel appears to be without effect.

Instead of the characteristic sharp click of the drop there was occasionally a softer, duller sound, and when this soft sound occurred the drop often left a bubble at the point where it had struck. In the case of the click no bubble was usually left.

I have no explanation to suggest for this series of sounds. If they depended on the shape of the drop when it struck the water we should not expect an abrupt boundary between the regions of sounding and the regions of silence, and we should expect the series of regions to repeat at distances proportional to the squares of the successive integers.

ARTHUR TABER JONES
SMITH COLLEGE

THE CRYSTAL STRUCTURE OF ICE

X-RAY photographs of ice were taken to determine its crystal structure following the method used by A. W. Hull.[1] The lines on the film correspond to those of the hexagonal system. They show that ice has a lattice which is built up of two sets of right, triangular prisms interpenetrating one another in the following way. Consider the plane containing the bases of one of the sets of prisms. The molecules lie at the vertices of equilateral triangles of side 4.52 Ångstroms. At a distance of 3.66 Ångstroms above this plane lies the plane containing the bases of the second set of prisms. Here the molecules also lie at the vertices of equilateral triangles equal to those of the first set, but each molecule is situated directly above the center of one of the lower triangles. The other molecules of the crystal will lie directly above the molecules of the two planes just described at intervals of 7.32 Ångstroms. The above values give an axial ratio of 1.62 in good agreement with the crystallographer's value of 1.617.[2] From

[1] *Phys. Rev.*, 9, 85, January, 1917.

[2] Gmelin Kraut, "Handbuch der Anorganischen Chemie," Heidelberg, Vol. I., 1, p. 107, 1907.

these data the number of molecules at each point has been calculated to be two.

This means that the molecule of ice must be of the form $(H_2O)_2$ or H_4O_2. The full data and calculations will be published in the *Physical Review*. D. M. DENNISON

RESEARCH LABORATORY,
GENERAL ELECTRIC CO.,
SCHENECTADY, N. Y.,
August 20, 1920

THE AMERICAN CHEMICAL SOCIETY. VIII

RUBBER DIVISION

W. K. Lewis, *chairman*

Arnold H. Smith, *secretary*

Discussion of report of committee on "Physical Testing."

A direct method for the determination of rubber hydrocarbon in raw and vulcanized rubber: W. K. LEWIS and W. H. MCADAMS. It has been shown by a volumetric method involving a double titration that the bromine consumption, corrected for the observed substitution is a true measure of the actual amount of pure rubber hydrocarbon known to be present. Although the amount of substitution increases with the length of the bromination period, the addition corresponds quantitatively to the actual amount of pure rubber hydrocarbon present when the bromination time is from two to four hours. Experimental data is given to show that the actual per cent. of $(C_{10}H_{16})n$ in vulcanized soft rubber can be determined by a volumetric bromination method herein described, involving a second titration to correct for the substitution which accompanies the particular analysis by titrating in dim daylight, this substitution correction can be made very small.

The value of shoddy in mechanical rubber goods: J. M. BIERER. A chart was presented which gave the cost relations between scrap rubber and reclaimed rubber. The value of this reclaimed rubber was evaluated on a basis of tensile strength and compared to a corresponding priced new rubber. A line of demarkation through the center of the chart showed where it was more economical to use new rubber or reclaimed rubber.

The recovery of volatile solvents: W. K. LEWIS. Solvents used in the rubber industry may be recovered by the use of any method such as absorption, compression or cooling. Ordinarily in the rubber industry the solvent vapor is diluted with a large quantity of air and in this case the absorption method is best. When such conditions are present so that one has concentrated vapors a compression method becomes available. Benzol used in pregnating cord tire fabric may be recovered with an efficiency of 90 per cent. by enclosing the impregnating apparatus and passing the vapors through an absorption tower. The danger of fire or explosion may be eliminated by passing flue gas into the apparatus.

On the determination of true free and true combined sulphur in vulcanizing rubber: W. J. KELLY. At present sulphur is considered as free and combined. Acetone soluble sulphur may be partly combined with resins, etc., as may also the sulphur insoluble in acetone, heretofore considered as combined with rubber. The total acetone extract is soluble in EtOH, but if EtOH saturated with sulphur is employed, none of the truly free sulphur will dissolve and hence can be separated from the remainder of the extract. Results show about 0.4 per cent. sulphur combined with resins, etc. About 85 per cent. of Heva resins are saponifiable and hence any resinous sulphur compounds insoluble in acetone may be soluble in alc. KOH. Acetone extracted sample is boiled 8 hours in 5 per cent. alc. KOH and about 0.26–0.30 per cent. sulphur extracted. Successive extractions do not increase this. Hence, the rubber is not being decomposed. These results are on pure gum and sulphur stocks and will be extended to compounded stocks later.

Analytical determination of the coefficient of vulcanization: S. W. EPSTEIN.

Small amounts of magnesia and certain organic substances as accelerators: G. D. KRATZ and A. H. FLOWER. The activity of small amounts of extra light magnesia as an accelerator was compared with the effect of similar amounts of certain organic accelerators. The load required to effect a given extension was found to be a fair measure of the rate of cure of the mixture which contained magnesia; however, this was not true for the mixtures which contained the organic accelerators. The accelerating activity of magnesia in small amount was found to be of secondary or contributory, character, acting in conjunction with, or in response to, certain extraneous substances, probably nitrogeneous, present in the rubber. The amount and nature of these extraneous substances was found to limit the activity of magnesia as an accelerator.

Diffusing power of pigments: W. K. LEWIS and F. P. BAKER. The diffusing power of pigments can be determined by measuring the weight of pigment per unit of cross sectional area necessary to obscure objects behind a suspension of the pigment, the result being expressed as square centimeters per gram or square feet per pound. The determination can be carried out in simple apparatus and results can be checked with accuracy. It is believed that the diffusing power is the most satisfactory measure of the fineness of a pigment, and as such is of obvious interest and value to the rubber trade.

The effect of compounding ingredients on the physical properties of rubber: C. OLIN NORTH. Compounding experiments in which from one to fifty volumes of filler, *i. e.*, gas, black, zinc oxide, etc., were added to 100 volumes of rubber are described. The values obtained for tensile strength, etc., are corrected back to the actual volume of rubber present and another set of curves drawn. Tensile strength calculated on area at rest is unfair to a soft stretching stock. Tensile at break is suggested as a better basis of comparison. This is obtained by multiplying usual tensile strength by final length and dividing by the original length times a correction factor, because of volume increase during a stretching. A visual picture of the physical structure of rubber, *i. e.*, network hypothesis based on the assumption that large colloidal aggregates function as elastic fibres and the smaller as plastic material is presented. Vulcanization probably locks up these fibers to form a network.

The microscopic examination of rubber and rubber products: HENRY J. MASSON and IRENE C. DINER. The authors presented the results of their investigation in the line mentioned in the title. Magnifications of from 500 to 2,000 diameters were used. Best results were obtained at magnifications of about 800 diameters. The ordinary methods of metallurgy were resorted to, both oblique illumination and vertical illumination being used. Photomicrographs were shown at the meeting of various samples which had been examined.

Rubber chemistry from the colloidal viewpoint: ELLWOOD B. SPEAR. The mechanism of crystallization, condensation, polymerization and coagulation was discussed. Gelation is one type of coagulation. Selective adsorption is given as a reason for the increased tensile strength of compound rubber. This deals with the different surface energy of rubber and the various compounding ingredients.

LEATHER CHEMISTRY SECTION

Louis E. Levi, *chairman*

William Klaber, *secretary*

The true tanning value of vegetable tanning materials: JOHN ARTHUR WILSON and ERWIN J. KERN. A new method of tannin analysis is described which determines exactly what is called for in the generally accepted practical definition of tannin, namely, that portion of the water-soluble matter of certain vegetable materials which will precipitate gelatin from solution and which will form compounds with hide fiber which are resistant to washing. The analyses of 10 common tanning materials by the new method and by the official method of the American Leather Chemists' Association indicate that the latter method is in error to the extent of from 43 to 220 per cent. The new method gives reproducible results and is considered entirely practicable.

The neutral salt effect and its bearing upon leather manufacture: JOHN ARTHUR WILSON and EDWIN A. GALLUN. The addition of neutral salts to the various liquors used in making leather is shown to have the effect of increasing the activity of all the constituents of such liquors, whether they be acid or alkaline. In the case of chloride salts, this was shown quantitatively to be due to removal of solvent by hydration of the added salt. The results of 37 experiments in chrome tanning with different kinds and proportions of neutral salts are given which throw considerable light upon the mechanism of chrome tanning.

The determination of sulfate in sulfonated oils: ERWIN J. KERN. In the determination of uncombined sulfate in sulfonated oils, the use of organic solvents can be dispensed with, if the usual brine solution be replaced by a 10 per cent. solution of monosodium phosphate, which gives a clear separation of solution and oil in very few minutes. After boiling the oil with hydrochloric acid, total sulfate may be determined in the same way. The phosphate solution extracts all of the sulfate in each case, which may then be determined as barium sulfate in the usual manner. A saving of time is effected by the new method.

A new method for the determination of sulfuric acid in leather: ARTHUR W. THOMAS.

Time factor in the adsorption of the constituents of chromi sulfate solutions by hide substance: ARTHUR W. THOMAS and M. J. KELLY.

The conductivity titration of chrome liquors: ARTHUR W. THOMAS and S. B. FOSTER.

Physico-colloidal interpretations of the tanning and tawing procedures: I. NEWTON KUGELMASS.

The currying of leather for belting: EDWARD E. MARBAKER.

Chemical work in the tannery: LOUIS E. LEVI.

SUGAR SECTION

C. A. Browne, *chairman*

Fred. J. Bates, *secretary*

Chemical control in the beet sugar industry: S. J. OSBORN.

The testing of saccharimeters by means of the telescopic control tube: C. A. BROWNE. Uses of the control tube are described (1) for determining the errors of saccharimeter scales, (2) for comparing scales, (3) for determining sensibility of saccharimeters, (4) for testing ability to polarize accurately, (5) for determining influence of personal equation. The maximum scale error on good instruments was found not to exceed 0.04° v. The probable error of a single reading on a German saccharimeter was $\pm .05$ and on a Bohemian $\pm .03$ or an average of $\pm .04$. Personal equation may produce a constant one way difference of $\pm .04$ between different observers. Reversing the optical construction of saccharimeters was found to reverse the order of personal equation. Disputes about the values of normal weights no doubt result partly from personal equation.

Observations upon the use of different types of saccharimeters: C. A. BROWNE. Observations are given of the good and bad features noted in the practical use of saccharimeters of American, English, French, German and Bohemian manufacture. The advantages and disadvantages are presented of the open and closed construction types of instruments, of the various forms of polarizers, of different kinds of saccharimeter scales, and their comparative accuracy, and of differences in methods of illumination, trough construction and other details. As a result of his inspection the author believes the outlook for the manufacture of accurate saccharimeters in countries outside of central Europe is most encouraging.

The filteration of sugar-juices and syrups: WALTER L. JORDAN.

The clarification of cane juice without chemical treatment: F. W. ZERBAN. Previous investigators have found that nearly three fourths of the impurities which are removed by treatment of cane juice with heat and lime, can be taken out by filtration in the cold, and that therefore the chemical effect of the lime treatment plays only a small part in clarification with this process. It was also shown by the same investigators that the greater part of these impurities exist in the juice in colloidal form. Conclusions based on these facts are further developed in this paper, and it is pointed out that the effectiveness of the various chemical clarification methods at present in use may in their broad outlines be explained by colloid-chemical considerations. It is very probable that surface energy, and particularly adsorption, is the principal factor in these classification processes. It follows from these theoretical considerations that cane juice clarification may be brought about without the use of any chemicals whatever, but simply by the use of efficient adsorbents. Laboratory and factory tests have given strong evidence that this is actually the case, and it was found that in comparison with the sulfitation process, at least the same quantity of first sugar of greatly superior quality can be made by clarification with one half per cent. Filter-Cel, followed by treatment with 1 per cent. Norit, and filtering the juice in both cases, which is easily and rapidly done. The first molasses is so very light in color that the recovery of high-grade sugar can probably be materially increased, still leaving a molasses of higher market value than that made by the usual plantation methods.

The Hess-Ives tint-photometer and its use with raw sugars: GEORGE P. MEADE and JOSEPH B. HARRIS. The scale readings of the Hess-Ives Tint-Photometer are meaningless in themselves as they do not express directly the relative amounts of color. It was found that the scale readings for solutions containing 1, 2, 3, 4, etc. units of material run in powers of the reading for one unit, considering the scale readings as decimal fractions. This is due to the mechanical make-up of the instrument, and is true no matter which color screen or what class of material is used. Expressed algebraically, this relationship between the scale readings and the amounts of color becomes $y = K^x$, where y is any scale reading, K is the reading for one unit of material, and x is the number of units of material required to give the scale reading y. By means of this equation solved for x the color of two materials may be compared, given scale readings for equal quantities; or all scale readings may be compared to a standard. To avoid the repeated calculations, a table has

been calculated which gives the units of color corresponding to each scale reading from 100 to 1. A convenient method for determining the color of raw sugars, using the table, is given together with results for various sugars.

The deterioration of Cuban raw sugar in storage: Nicholas Kopeloff and H. Z. E. Perkins. From the results indicated below, a correlation between the number of microorganisms and the moisture ratio is indicated which appears to make it possible to predict the keeping quality of a sugar by a preliminary bacteriological and a chemical analysis. Cuban raw sugars (with moisture ratios varying from .22 to .49) were stored under normal conditions in a large warehouse for 5½ months and analyzed chemically and bacteriologically. There was a loss in polarization at the end of this period, as well as at the end of one month, which was generally accompanied by a gain in reducing sugars. Likewise a gain in moisture content and reduction in the factor of safety was noted. There was a decided increase in total number of microorganisms after one month, which could be correlated within certain limitations with deterioration. Where there was a large initial infection, deterioration was rapid. In general there were more microorganisms in the middle of the bag than at the surface. Bags designated as wet, stained or having sugar light in color, deteriorated more rapidly than when drier, unstained or dark in color. In bags of sugar which are deteriorating rapidly, the surface deterioration is greatest, while in less rapid deterioration the middle of the bag seems to undergo greater decomposition. Deterioration was found to be proportionately greater over a longer incubation period than in one month.

The development of the polarimeter: Noel Deerr. A brief account is given of the development of the polarimeter beginning with the earliest instrument of Biot and continuing with the subsequent improvements of Nicol, Ventzke, Mitscherlich, Soleil, Duboscq, Jellet, Cornu, Laurent, Lippich and others. The three major inventions in this development are the prism of Nicol, the quartz wedge compensator of Soleil and Duboscq, and the photometric end-point of Jellet. German science has contributed nothing elementary to this development, although the manufacture of polarimeters has been allowed to become almost exclusively Teutonic.

Changes in the analytical ratios of sugar during refining: A. F. Blake.

Boneblack and decolorizing carbons: W. D. Horne. Investigators of Boneblack and decolorizing carbons should bear in mind the practical working conditions to be met by these substances. Boneblack or substitutes should exist in grains of 16 to 30 mesh and should be hard, very porous and high in absorptive power for iron as well as for coloring substances. Carbon is not necessarily a constituent, and a more easily cleansed and revivified substance is needed. Decolorizing carbons need to be more absorbent of ash and of red coloring matters such as caramel, and cheap enough to discard after using a few times.

The production of the gum, levan, by mold spores: Nicholas Kopeloff and Lillian Kopeloff. Mold spores contain an enzyme capable of forming gum in sugar solutions of all concentrations up to the saturation point. Pure gum was obtained by precipitation with five volumes of alcohol in alkaline solution and the specific rotation found to be about —40. Upon hydrolysis with acid, levulose was formed. Its melting point was about 200° C. The gum was considered to have properties identical with levan, previously noted in the bacteriological decomposition of sugars by Greig-Smith and Owen. A new method of determining levan and actual sucrose in sucrose solutions was established by using the invertase method (pure invertase solution prepared from yeast) in conjunction with the usual Clerget procedure. Some data have likewise been obtained which indicate the nature of the sugars from which levan is formed.

The determination of moisture in beet sugar factory products: V. L. Aikin.

Charles L. Parsons,
Secretary

(*To be continued*)

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.
NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

Friday, October 1, 1920

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

SCIENTIFIC RESEARCH IN RELATION TO AGRICULTURAL PROBLEMS[1]

I am proud of having an opportunity to assist at the birth of this new society. In this case it seems that parturition has been long overdue—perhaps owing to the size of the embryo, if one may judge by the secretary's statement of membership. At any rate it proves to be a very vigorous healthy youngster and since it will be watched over by all these experts in nutrition, diseases, etc., one can safely predict for it a rapid growth and active maturity.

I must ask you not to estimate my modesty by the title of my remarks, which appears on the program—"Scientific research in relation to agricultural problems." This very large subject has been assigned to me by your committee and one consents to discuss it on the present occasion only because the relationship of scientific research to the industries *in general* has recently been thoroughly discussed and forcibly brought home to every one. The relationship of scientific research to agriculture is only a particular phase of this general question which has been frequently and ably discussed from many quarters. It would serve no useful purpose to point out particular agricultural examples of principles which should be familiar to all scientists. It will, therefore, not be necessary to attempt a comprehensive treatment of the subject. It will be sufficient to point out certain respects in which the relationship is peculiarly important to agriculture, or in which agriculture differs from the other industries. In accordance with the desire of your committee, I shall speak largely from the standpoint of the so-called pure scientist.

Agricultural scientific research suffers more

[1] Address delivered at the organizing convention of the Canadian Society of Technical Agriculturists, Ottawa, June 3, 1920.

than does any other form of industrial research from a lack of realization on the part of the general public of its possibilities. This is due, I believe, to the familiarity on the part of the majority of people with agricultural operations. Any one will concede the value of research in relation to manufacturing industries involving chemical actions. The great majority of people are innocent of any knowledge of chemistry, and regard it as a highly complex, mysterious study capable of performing all sorts of wonders—in which opinion they are not discouraged by the chemists. But every one thinks he knows something of agriculture and many people think they are experts at it. To most people agriculture is simply taking a little care of plants and animals which would grow anyway. They can see no need of investigation in such familiar operations as ploughing, harrowing, harvesting and thrashing. And it is through average public opinion that the expensive support for research must be obtained. The head of an agricultural college informs us that it has just taken him three years to convince his board that a plant pathologist has any useful duties to perform.

Of course all technical agriculturists know that agriculture, like the other industries, has reached a stage at which little progress can be expected from casual observation or ordinary experience. Progress will result only from the careful application of scientific facts and principles which are known only to those who have been properly trained, or which have not yet been discovered. Agricultural problems are just as difficult and complex as those of any other industry. Our confidence that great progress will be made by the application of scientific principles in agriculture results from our knowledge of what has been accomplished in this way in the past. The achievements of agricultural scientific research in actual financial benefits to the country are not surpassed by those of any other industry. This is not the occasion, however, either to mention the problems which have been solved or to point out those which can be solved by the application of scientific principles. Owing to the fact that such a large proportion of our population must always be engaged in agriculture, any advance through scientific work must result in benefits which in the aggregate surpass those in other industries.

My second point is that technical research in agriculture involves research in an unusually wide range of basic subjects and that the technical researcher in agriculture is therefor peculiarly dependent on so-called pure science. Agricultural problems involve, among other things, the physics, chemistry, biology and geology of the soil, physiology of plants and animals (itself including many basic subjects), pathology of plants and animals, systematic biology, including entomology, foreign plant introduction, genetics, bacteriology, mechanics, climatology, sociology and economics. Many problems involve several of these subjects. There are, of course, routine problems such as testing varieties, rotations, etc.; which may involve little more than general agricultural knowledge. But the problems which will result in new departures of importance are likely to demand a profound knowledge of basic subjects. The big advances requiring only superficial science have mostly been made, and progress in future will depend more and more on profound study in more than one basic subject. The workers in these basic subjects supply the raw material—scientific information—which the technical agriculturists work up into manufactured articles—better agricultural practises. To sustain our metaphor further these manufactured articles are transported by the agricultural educationists to the consuming farmers.

Of course, as in other cases, the workers in these different fields ("fields" is surely a good word in an agricultural discussion) can not be sharply segregated. Many technical men engaged primarily in improving practises are also spreading information among the farmers; many of them are making discoveries in theoretical science. The same piece of work may involve both discovery and application. To use a simile from our own subject, the technical agriculturist may be considered a cross between the so-called pure scientist and the farmer. And as in Mendelian crosses, there

are degrees of dominance with respect to the contrasted characters of the parents. Sometimes the technical man is mostly pure farmer, sometimes mostly pure scientist, sometimes exactly intermediate. Not rarely the cross proves too wide and the offspring are completely sterile.

Owing to the unusually wide range of basic subjects this relationship of pure and applied science is peculiarly important in the case of agriculture. It is hopeless to expect a technical agriculturist to keep thoroughly posted in all the subjects ancillary to agriculture; it is equally hopeless to expect a worker in an ancillary science to keep posted on practical agriculture. There is need of special machinery to stimulate discoveries in those parts of the basic subjects related to agriculture and to provide for their immediate application.

The solution of this difficulty and others presently to be mentioned depends, in my opinion, on a large degree of organized cooperation in research. All the reasons in favor of cooperation in industrial research in general apply in the case of agriculture and these strong additional reasons.

The peculiar dependence of technical research in agriculture on research in a wide range of basic sciences demands cooperation between the pure scientist and the technical man. A technical agriculturist endeavoring to solve a practical problem is very likely to encounter a fundamental problem. A fundamental researcher is very likely to uncover a fact or principle which can be immediately applied—if he knows enough of the practical to make the application. Sometimes a technical man's duties and interests and training will permit him to follow up a fundamental lead. Sometimes a worker in a fundamental subject, may know enough of the practical and possess the inclination to make the application. But such cases are likely to be relatively rare. It seems obvious that the best results both from the practical and theoretical standpoints are to be obtained by close cooperation of all concerned. The practical man knows the problems and discovers where fundamental information is lacking in order to solve them. He can then enlist the services of the pure scientist in those problems which his duties, or training or interests will not permit him to attack. At the same time—and this is not the least important effect—theoretical science will be advanced. There will be a complex series of effects and counter-effects of the theoretical on the practical. It can not be too strongly emphasized that theoretical science receives as much from practical science as it gives to it. The theoretical advances made in practical research are as important as the practical advances made by the application of theoretical principles. And in agricultural problems the possibilities are particularly great.

I should like to refer to a particular example of what I have in mind. A very practical problem is the breeding of disease resistant plants. In the case of stem rust of wheat it turns out that the problem involves fundamental genetical work. But the prosecution of it requires a very substantial knowledge of plant pathology and its methods; it can be carried on best in collaboration with plant pathologists. Moreover it has recently given a very valuable lead in fundamental botany by showing the existence of many physiological and geographical races of rust which can be distinguished only by their virulence in particular varieties of wheat. Stakman and his collaborators have proven the existence of many of these geographical races in the Northern States and work at Saskatoon this year has demonstrated the existence of several scattered over western Canada, as well as the occasional occurrence of more than one race in the same locality. This discovery seems for the time to have made a practical solution impossible. But the point is that the geneticist and plant pathologist have had to collaborate on the problem and both have uncovered important leads for theoretical research. And before economic results are obtained the practical agronomist must be enlisted to test yields, earliness, etc. This investigation also shows the necessity of having the same work carried on concurrently at different places to meet varying local conditions.

Many of the most important problems in agriculture will in this way require the united efforts of several kinds of researchers. This must be true from the very nature of agricultural problems involving as they do a highly complex sort of conditions and a very wide range of basic subjects. Without cooperation we find the technical man necessarily spreading his efforts over so many subjects that he accomplishes little. This result is already too common. Without cooperation we find the pure scientist making foolish practical claims or helpless before an unusual practical situation. Nor will the best results be obtained when the cooperation consists of the fundamental scientists acting as chore boys for the technical men—performing their chemical analysis, physiological experiments or bacteriological identifications.

Apart from the need of workers of several kinds, many problems are so big that even where only one kind of researcher is necessary, several of these must collaborate if results are to be obtained in reasonable time. Again, in Canada local and environmental conditions are so highly varied that in the case of problems of nation-wide importance work must be carried on concurrently at many places.

With the argument that cooperation is necessary in order to avoid duplication of effort I have no great sympathy. We need both collaboration and duplication or collaboration *by* duplication. We all know of too many cases where claims have been made which have not been justified by the scientific work, which have injured scientific agriculture, and which would never have been made by several men working together. The cry of needless duplication of effort has been overdone; until agriculturists become infallible we can stand a great deal more duplication. It should, however, be deliberate duplication knowingly undertaken, not that of several men working in ignorance of each other's efforts.

That organized cooperation in research can accomplish a great deal when support is available, has been abundantly proven by the war experience of all nations.

In this society we have the machinery at hand to bring about the needed cooperation. This society will soon bring together all Canadian technical agriculturists and, I hope, all researchers in fundamental subjects whose work is in any way related to agriculture. Projects to be attacked can here be divided into phases and each man assigned the phase in which he is best qualified or most interested. Varying local conditions can be met by providing for the concurrent prosecution of similar work in different places. The groups must be democratically organized and cooperate freely; they can not function if one man assigns tasks to others. There is no need of entering into details at this time. They can be worked out to suit the problem.

Such a program will require frequent group meetings for consultation, formulating and modifying plans, reporting results, etc. These meetings can best be held in connection with the conventions of this society. On account of the great distances involved, it will be necessary that the institutions to which these men are attached should pay their travelling expenses. I believe that little difficulty will be encountered in this respect. Certainly these institutions could spend their money in no way which would be likely to yield more valuable results, not only in actual problems solved but also in keeping their staffs efficient.

That a program of consultation and collaboration will receive wide support is shown by the resolutions passed at the conference of deputy ministers of agriculture recently held at Ottawa. A resolution concerning experimental farms passed at that conference reads, in part, as follows:

Be it resolved that . . . definite measures be adopted that will bring about greater cooperation in planning, conducting and giving publicity to the results of experimental farm work, to wit:

(*a*) The formation of joint provincial advisory committees to be composed of representatives from the Dominian and provincial departments of agriculture. . . .

(*b*) That such provincial committees shall meet not less than once annually to consider the results of experimental work . . . for the preceding year or years and to discuss and as far as may be pos-

sible recommend and approve contemplated lines of experimentation for ensuing years with a view to building up a system under which the work of the respective stations shall, as far as possible be supplementary to and correlated with each other. . . .

(c) That from time to time . . . conferences of these committees or representatives thereof from groups of provinces or all the provinces be held. . . .

Another resolution with respect to plant breeding reads, in part, as follows:

Be it resolved that plant breeding work in Canada whether carried on under federal or provincial direction should be fully coordinated and correlated by the holding of conferences of Canadian plant breeders . . . that the mode of extension (of plant breeding work) be arranged by conference from time to time between federal officers and the officers of the provinces concerned so as to avoid duplication of effort and attain the maximum degree of efficiency.

It is of course possible that local jealousies and personal affairs may interfere with the working out of such plans. I have heard of an institution where one kind of worker may study an insect so long as it remains in the air but as soon as it penetrates the hide of a cow he must not seek to follow it; it then becomes the property of a different subdepartment. If it digs into the ground another subdepartment claims it. I know that some technical agriculturists are constantly on the watch lest a botanist or chemist tread on their preserves, and that some pure scientists have "no trespassing" signs up for technical agriculturists. When members of the same department quarrel over such things we may expect trouble in a larger organization. The division of credit for work done may cause some heartburnings. But I believe the good sense of all concerned and the desire to get results will overcome all such difficulties. And a little experience in cooperative work will soon convince every one of the essential decency of scientific colleagues.

Such work need not interfere with any one's initiative, and no matter how much cooperation may be secured in solving practical problems, undoubtedly much of our progress will continue to depend on individual brains and initiative and imagination. Cooperation can not replace intellect but it can make intellect much more effective in solving certain kinds of problems.

Moreover it must be remembered that cooperation can be effective only with certain kinds of problems. The problems must be clean-cut, easily outlined. The end sought must already be perfectly clear; the probability of success must be demonstrable; the methods of attack must be fairly obvious from the data at hand. But there is another kind of studies—those which really open up new fields of interest and importance. These studies must be highly individual and do not lend themselves to cooperation. Such problems can not be outlined because they are not known or are perceived only vaguely. One gets a hint but the end of the trail is not clear; the success of the work is doubtful or may appear ridiculous. The project can not be outlined so clearly and attractively as to enlist the help of colleagues or the support of executive boards which control funds.

And just here, it may be remarked, is a defect inherent in all institutions and organizations whose specific purpose is the carrying on or support of research. The directors or chiefs can not give financial support unless the problem can be clearly outlined, and the probability of its solution demonstrated. They must thereby exclude many of that second and higher type of researches to which I have referred. If Mendel had had to ask the prelate of his monastery for land and labor to carry on his experiments, he could not have justified his request by predicting the discovery of his law of heredity. There is after all some advantage in holding a teaching position in which one can potter at whatever notions one conceives without having to justify them to some one controlling his salary and without having to give reports at intervals. We teachers are not as envious of you full-time research men in governmental positions as you might suppose.

For the same reason it would, in my opinion, be a mistake to do anything that would tend to concentrate research in governmental departments or institutions. Every teacher

should be encouraged to work at whatever problems he wishes to attack. When a man's teaching or other duties are sufficient to justify maintaining him and yet leave him time for research he is more likely to choose problems which break new ground than if every research has to be justified even for the reason that he is paid a salary for research.

There must in general be no restriction on a man's choice of problems or on the distance to which he may follow a research lead. For this reason I must object to the suggestion made to-day that provincial men confine themselves to problems of provincial importance and that problems of wider significance be reserved for the Dominion Department of Agriculture. One never knows where a trail is going to lead—that is one of the chief attractions in investigation work. If a worker in Saskatchewan uncovers a trail which leads over in Manitoba or Ontario or the States, he won't stop at the boundary. The wider its significance the harder he will follow it. Our most important provincial problems are of equal importance outside provincial boundaries. You can not say to a provincial man "You may study these little local questions, but you must leave the big things to the Dominion men at Ottawa." Only a very mediocre set of men would endure such a restriction.

Apart from helping by cooperation in the solution of practical agricultural problems, the worker in a basic subject can do a great deal by a judicious choice of problems and materials. A geneticist or plant physiologist for example in attacking a fundamental problem can use a crop plant of great economic value just as well as the usual greenhouse plants. At the same time he is likely to reveal, perhaps incidentally, perhaps directly, information of great practical importance concerning this plant. Our scientific men could attack these problems on the borderline between the theoretical and the practical. They could attack a practical problem not only for its own sake but in the full expectation of uncovering a theoretical lead. In many cases in the past they have not attacked practical or semi-practical problems partly because of ignorance concerning them, partly for fear of offending technical colleagues.

Another difference between research in agriculture and that in the other industries concerns the remuneration of the workers. The industrial research man shares, in part at least, in the financial benefits which accrue from his work. Great increase in wealth results from the perfection of a technical invention. Even if the researcher is a hired employee of a corporation he shares handsomely in the benefit. The industrial researcher therefore always feels the powerful financial stimulus.

The agricultural researcher, on the other hand, deliberately renounces all such rewards. In that respect he is like the pure scientist. Though his work may result in great financial benefit to his country, he knows that he will profit not at all or very slightly. From the nature of his work he must be attached to governmental or educational institutions, and he knows that the salaries in such positions can never be very large. But when for the sake of his work he renounces hope of becoming wealthy, he can surely expect a reasonable salary. If good researchers are to be retained in and attracted to agricultural work, the remuneration must be sufficient, not to compete with what other industries offer to research men, but to make possible comfortable habits of life. Our standard joke concerning the salaries of teachers is unfortunately just as applicable to positions in which the teachers are also researchers and to those in which research only is carried on.

There is another aspect of the relationship between scientific research and Canadian agricultural problems to which I must refer, namely, the educational aspect. It should be perfectly clear that the men who are to do worth-while investigational work in agricultural problems must have a thorough training in the basic subjects as well as a broad education in the languages and humanities. As I have already pointed out, a thorough understanding of agricultural questions demands a peculiarly broad acquaintance with many fundamental subjects. The problems of agriculture involve just as complex scientific con-

ditions as do those of medicine or engineering for example. And the men who are to solve them must have just as broad and thorough a fundamental training as the researcher in medicine or engineering. Moreover, apart from his research, the technical agriculturist has to face just as many situations requiring broad education and culture as have any other professional men.

Now the medical colleges require the equivalent of two years of arts work with specified large credits in the sciences, before admission is granted to the purely medical studies. Some indeed require full arts graduation and all medical authorities advise graduation in arts even where they do not require it. All this is required of those who are to become only general medical practitioners. Much more is necessary for the research man.

Similar conditions are found in regard to the training for other professions. In engineering, law, divinity, a broad fundamental training is considered necessary and is generally required. At the recent Canadian universities conference held at Quebec a resolution was unanimously adopted calling for large increases in English, history, economics and particularly fundamental science in the training of engineers. The ideal of all educationists in these professions is to secure complete arts graduation before admission to professional studies, and failing that a large and specified amount of arts work.

In my opinion the professional agriculturist should have just as thorough a pre-professional training. This is true not only for the researcher in agricultural problems but also for agricultural teachers in schools or colleges, district representatives, inspectors, laboratory men and various administrators.

In those institutions which include both arts and agricultural colleges, it should be easy to arrange for such training. The pre-agricultural students should be taught in the same classes as the pre-medical students, or pre-engineering students, or straight arts students. In other places the students may not be given the formal arts classes but he should get the equivalent of them in a thorough broad training during the first two years. In all cases, if he is to benefit by his work, complete matriculation should be demanded before the student is permitted to enter. It is essential pedagogically that the basic subjects be taught before the student takes up the professional ones. They should certainly not be tacked on after the student has taken his professional work. This will involve an almost complete separation of the courses for technical agriculturists from those for the men who are to return to the farms. In short our ideal should be to bring our professional agricultural training abreast of our training for other professions by requiring as pre-agricultural study a large amount of, and as soon as possible complete, arts work. Only in this way can we secure a supply of properly trained research men as well as of other technical agriculturists.

The educational aspect of the relationship also involves the question of graduate work which is a very passing one in Canada. But as that is to be dealt with by another speaker, I shall refrain from discussing it.

I said at the outset that I would not attempt a comprehensive treatment of the subject—in spite of the time I have taken. I have tried to emphasize four respects in which, in my opinion, the relation of scientific research to agriculture is peculiarly important in Canada at the present time. They may be designated (1) Foundation, (2) Cooperation, (3) Remuneration and (4) Education.

W. P. Thompson

University of Saskatchewan

LIMITATIONS OF EXPERIMENT IN EXPLAINING NATURAL HABIT, AS ILLUSTRATED BY THE DIURNAL MIGRATION[1]

The general facts about the diurnal distribution of plankton organisms are these: at night there is greater abundance of a given species at higher levels and less abundance at

[1] A paper read at the meeting of the Western Society of Naturalists, Pasadena, California, June 20, 1919.

lower levels; by day the abundance is less at higher levels and greater at lower levels. One form may have a vertical range from the 100 fathom to the 200 fathom mark and another may range from the surface to 50 fathoms. The increase in numbers in the upper strata at night is believed to be due to upward movement of the animals from lower levels; the increase in numbers below the surface during the day is held to be due to descent from higher levels. The whole phenomenon is spoken of as diurnal migration.

The explanation of such movements has often been attempted. The one that has been most in vogue is based on change in direction of movement as some external condition is altered. That is, reactions are involved in the varying relations between the environment and the distribution of the organisms. Since the vertical movement is rhythmic and corresponds to the change between day and night it seems reasonable to suppose that the direction of movement changes as the light intensity changes; the animals might move toward a light of low intensity and away from one of higher intensity. Again, evidence has been presented showing that the geotropism of some forms changes with the light intensity. It has been thought, furthermore, that alterations in temperature or salinity are accompanied by reversals of direction of movement, either with relation to a source of light or to gravity. There is reason for this view since the organisms actually pass through different temperatures and salinities as they move up and down.

The foregoing possibilities all exist. But such questions as these have arisen: How generally do the possibilities apply? Are they applicable to all plankton animals? Do reversals in direction of movement really take place as it is possible they may? An investigation of such questions occupied the time of the writer for a year at the Scripps Institution. The reactions of different plankton animals were studied, with the special point in mind of applying the results to the diurnal migration problem. The attempt was made to find out for each species whether movement is toward or away from a weaker or stronger light; whether specimens ascend or descend in darkness as compared with diffuse light; whether locomotion in a vertical direction is toward or away from a light at the top of a column of water; whether direction of movement under any of the foregoing conditions changes if the temperature or salinity is changed.

It would be out of place to go into details here, but it should be said that experimental data that may show why the diurnal movement takes place were not obtained except in the case of the chætognath, *Sagitta bipunctata;* this form is one of seven that were used consistently. There is good evidence from field records that all of the species used in the experiments perform the diurnal migration. Furthermore, the field data from the San Diego region relating to one of the copepods and to *Sagitta* have been more completely worked out than for any other marine plankton animals anywhere. The relation between abundance or scarcity of these forms and external conditions revealed by collecting records, is thoroughly well known.

While the experiments that have been mentioned did not show how behavior in the laboratory is related to diurnal migration, they did bring to light matters that are certain to affect the interpretation of experimental results as applied to an explanation of a natural habit. It may be suggested, also, that these matters will probably enter into any study of reactions whose purpose is to discover the reasons for a given sort of behavior under natural conditions. The following are the points which seem to be of general importance.

1. Specificity in behavior. There is no doubt that a general explanation of diurnal migration is possible only when the different species have been studied in the laboratory; and it may not be possible even then to account for the diurnal migration as a general occurrence in the plankton. Various animals perform the migration together, but the reasons are different for the different forms. "Blanket explanations" have been given which are misleading because the reaction differences between species were not appreciated. One should not attempt to account for the vertical migration

of a copepod on the same basis that one explains a similar habit in a chætognath.

2. There is something connected either with the removal of specimens from the sea or their retention in the laboratory, or with both, that affects the responses in some cases. The relation between the behavior in the laboratory and that in the sea is consequently obscured. For example, the copepod, *Calanus finmarchicus*, can be taken at twenty fathoms during the day. When removed to the laboratory these animals are positive to light for about an hour on the average but become negative and remain so persistently. Is it not obvious that such a reversal makes it difficult to know how to apply experimental results toward explaining the migration? This kind of thing did not appear in all the species that I used, but it certainly should be looked for in all cases.

3. Specimens of the same species, but obtained from different locations or habitats, show noteworthy differences in behavior. A good example of this is found in the reactions of a copepod, *Acartia tonsa*. If animals are used that were obtained at the surface they move toward the light, and they ascend in diffuse light though they descend in darkness. But if the specimens were obtained from deeper water (60–100 feet) they move away from the light and descend both in diffuse light and in darkness.

Suppose that one is attempting to explain the diurnal migration of *Acartia*. The results of experiments with surface animals would lead one to expect to find the animals at the surface during the day and at lower levels at night. While they may be found at the surface by day at times, we have thousands of collections which show that these copepods are much more abundant at the surface at night. It depends on the particular animals collected whether it shall be said that *Acartia tonsa* as a species is positive or negative to light. It is worth noting in this connection that specimens of *A. tonsa* from deep water, if left in the laboratory for several hours, will react as surface animals do.

4. Need of experimental and field data together. It does not seem possible that the facts of nor the reasons for the diurnal migration (or any other natural habit) can be obtained without both laboratory and field studies. The results of work in the field will show what the animals do in their natural surroundings, while experimental work *may* show why they act as they do. Experiments are incapable of revealing what occurs in a natural habitat, unless it is possible to duplicate nature in the laboratory and at the same time secure experimental control. One can hardly do better in this connection than to quote what another has written:

> What right has one to assume that the reactions of an animal taken rudely from its natural habitat and as rudely imprisoned in some improvised cage are in any scientific sense an expression of its normal behavior either physical or psychical? Is it within the range of the calculus of probability that conclusions drawn from observations made upon an animal in the shallow confines of a fingerbowl, but whose habitat has been the open sea, are trustworthy? . . . Laboratory appliances are indispensable. But at the same time it must be recognized that they are at best but artificial makeshifts whose values, unless constantly checked by appeals to nature, must be taken at something of a discount.[1]

Such statements as the foregoing can not apply to experimental procedure that attempts to ascertain what animals can do, for example, or how sensitive they are to stimulation. Strictly physiological studies are both necessary and important and their brilliant results more than justify them. But in such methods of working the agent is emphasized rather than the organism, and the aim is to "work out the physics and chemistry of biological phenomena."[2] When, however, the organism is the chief interest, the natural history of the organism must be known if we are to study nature instead of things in a laboratory. Laboratory studies are of no more importance than those made in the field if one's object is to get

[1] Charles W. Hargitt, *Jour. An. Behav.*, 2, pp. 51–52, 1912.

[2] H. S. Jennings, *Amer. Jour. Psych.*, 21, p. 353, 1910.

knowledge of living things as they are in nature.

CALVIN O. ESTERLY
SCRIPPS INSTITUTION OF THE
UNIVERSITY OF CALIFORNIA

SCIENTIFIC EVENTS

THE BRITISH NATIONAL PHYSICAL LABORATORY

THE British Department of Scientific and Industrial Research announces that the report of the National Physical Laboratory for the year 1919 has now been issued. It contains among other matter the report of the executive committee for the year 1919, the statement of work proposed for the year 1920–21, a list of papers published by the laboratory during the years 1917–18 and 1919 or communicated by members of the staff to scientific societies or to the technical journals, and the report of the director for the year 1919.

Some particulars of special work done during the war which it was previously necessary to treat as confidential are included, and the descriptions of such work now given will, it is hoped, be found of interest. This special work includes gauge testing carried out for the ministry of munitions, and a large number of special researches carried out by the electricity and metallurgy department and by the William Froude national tank.

The heads of the various departments give accounts of the recent work of the laboratory as follows:

Physics Department.
- I. Heat:
  - (a) High Temperature and General Work,
  - (b) Thermometer Testing,
  - (c) Oil Apparatus Testing.
- II. Optics.
- III. Radium and X Ray work.
- IV. Tide Prediction.
- V. Library.

Electricity Department.
Metrology Department.
Engineering Department.
Aerodynamics Department.
Metallurgy Department.
The William Froude National Tank.

THE FAIRPORT FISHERIES BIOLOGICAL STATION

THE new building will be dedicated on October 7. The formal exercises will be divided into two parts—a forenoon session devoted to the immediate service of the station to industries and an afternoon session to consider the functions of the station in the advancement of science and the possibilities of further economic applications of its work. At each session there will be a principal address and three or four brief talks or messages. The speakers will be men of distinction in science and in public service. Opportunity will be afforded for inspection of the establishment, and, at suitable times to be appointed on October 7 and 8, scientists, state officers and other guests in attendance will be invited to confer regarding its purposes and work.

The reservation is on the Mississippi River, twenty miles below Davenport, and nine miles above Muscatine, Iowa. It comprises 60 acres of ground extending from the bank of the river to an elevation of about 200 feet above the river. Principal buildings are the biological laboratory, tank house, pumping station, hatchery (temporary laboratory), shell-testing plant and cottages. There are two water systems—unfiltered river water with storage reservoir of 2,000,000 gallons capacity and filtered water with gravity sand filter and low and high pressure cisterns. There are thirty-one ponds, of which nine are concrete-lined, while the remainder have walls and bottoms of natural earth.

The former laboratory building, opened in 1914, was of frame construction, about 100 by 50 feet, with two full stories, half basement and attic. It was destroyed by fire December 20, 1917, with the loss of a valuable library and many scientific records and specimens. The new building has the same location and approximately the same external dimensions as the old, but experience gained during occupancy of the first building and the resourcefulness and skill of the architect, have combined to make the new one superior in available space, convenience and serviceability.

The present structure, which is of concrete, stone, and brick, has a fully finished basement besides two full stories and a finished third story over the center and larger portion of the building. The present laboratory accommodations for 16 investigators can be extended by conversion of other rooms into laboratories. A well-lighted library, chemical laboratory, photographic room, museum, tank and aquarium rooms are other useful features of the building.

The architect of the building is James M. White, professor of architecture and supervising architect of the University of Illinois, who freely gave his professional services to the national government.

EXPEDITIONS OF THE BISHOP MUSEUM

Three parties of the Bayard Dominick Expedition from the Bishop Museum are now in the field. The Marquesas Island party consists of Dr. Edward S. Handy, ethnologist; Dr. Ralph Lauton, archeologist; Dr. Forest B. H. Brown, botanist. E. W. Gifford and Wm. C. McKern are conducting an ethnographic survey of the Tonga Islands. R. T. Aitken and John F. G. Stokes, ethnologists, are undertaking an anthropological study of the Austral Island group. Two additional botanists are to be appointed in October.

The scope of the cooperative work of the American Museum of Natural History and the Bishop Museum, under the direction of Dr. L. R. Sullivan, has been expanded to include a comprehensive anthropologic survey of the people of the Hawaiian Islands. It will include studies of the Hawaiians, Japanese, Chinese, Portuguese, Koreans and Anglo-Saxons. Particular attention will be given to full blood and mixed blood Hawaiians and to skeletal remains in ancient burial caves.

It is announced that the Young Collection of Polynesian ethnological material, the result of twenty years' work in the society, Marquesas, Easter and Paumotu Islands by J. L. Young, has been obtained by the Bishop Museum.

SCIENTIFIC NOTES AND NEWS

Sir F. W. Dyson, astronomer royal, Greenwich, has been elected an honorary member of the American Astronomical Society.

Professor T. D. A. Cockerell, of the University of Colorado, has been elected an honorary fellow of the American Museum of Natural History in recognition of his distinguished services to science.

Dr. William Mansfield Clark, physical and biological chemist at the Dairy Division, Bureau of Animal Industry, U. S. Department of Agriculture, has become head of the chemical division of the Hygienic Laboratory.

Dr. Amadeus W. Grabau, for eighteen years professor of paleontology at Columbia University, has been called by the Chinese government to a professorship at the University of Peking. He also has been appointed a member of the Chinese Geological Survey. Dr. Grabau will remain for three years in China to build up geological research work for the Chinese government.

Mr. James T. Newton, commissioner of patents, has resigned, after thirty years of service in the Patent Office.

Mr. Leslie Spier, assistant in anthropology in the American Museum, has been appointed associate curator of the museum of the department of anthropology in the University of California.

Dr. Rodney B. Harvey, formerly plant physiologist in the Division of Plant Physiological Investigations, Bureau of Plant Industry, who resigned to accept the position of assistant professor of plant physiology in the University of Minnesota and assistant plant physiologist in the Minnesota Experiment Station, has been retained on the rolls of the bureau as collaborator under a cooperative arrangement.

Mr. Hoyt S. Gale, who recently returned from Bolivia, has resigned from the U. S. Geological Survey, to take up private work.

Benjamin Richard Jacobs has resigned from the Bureau of Chemistry, U. S. Department of Agriculture, to become director of the

National Cereal Products Laboratories, with offices in Washington, D. C.

PROFESSOR HAROLD R. HAGAN has resigned as professor of zoology and entomology at the Utah Agricultural College.

DR. CHARLES E. SIMON, professor of clinical pathology at the University of Maryland, has severed his connection with that institution and has accepted the position of a lecturer at the School of Hygiene and Public Health of the Johns Hopkins University. He has also been appointed managing editor of the forthcoming *American Journal of Hygiene,* of which Dr. William H. Welch is the editor in chief.

THE Mary Kingsley medal has been conferred on Professor G. B. Grassi, professor of comparative anatomy at the University of Rome, for his research on the transmission of malaria by mosquitoes and the development of the hematozoa in the mosquito body.

PROFESSOR J. B. FARMER, professor of botany in the Imperial College of Science and Technology, London, has been appointed a member of the advisory council to the Committee of the Privy Council for Scientific and Industrial Research.

MR. B. B. WOODWARD has retired from the British Museum (Natural History) but will complete his catalogue of the natural history library.

PROFESSOR HERBERT E. GREGORY, who by a cooperative agreement with Yale University is serving as director of the Bishop Museum. Honolulu, has returned to New Haven and will resume his university work for the first half of the present academic year.

DR. S. I. FRANZ, of George Washington University and the Government Hospital for the Insane, represented the American Association for the Advancement of Science at the recent Cardiff meeting of the British Association. The General Committee has resolved that national associations for the advancement of science shall in future be invited to send representatives to meetings of the British Association.

W. S. KEW, on leave of absence from the U. S. Geological Survey, has left California for private work in Sonora, Mexico.

L. W. STEPHENSON has returned from Mexico and is acting chief of the Coastal Plains section of the U. S. Geological Survey, during the absence of T. Wayland Vaughan who attended the Pan-Pacific Scientific Conference in August and is spending the rest of the summer in study and correlation of the marine Tertiary strata of the Pacific coast.

DR. F. W TRAPHAGEN, professor of metallurgy in the Dakota School of Mines, has returned to Rapid City, South Dakota, after spending the summer in metallurgical research work for the Denver Metals Co., at their plant at Utah Junction, Colo.

DR. LEWIS WM. FETZER has resigned as professor of physiology and pharmacology in the Baylor University College of Medicine, to take charge of the laboratories of St. Paul Sanitarium at Dallas, Texas.

A COMMITTEE was organized in 1910 to collect funds for a monument to Lombroso. The committee had concluded its task when the war broke out but the execution of the monument was deferred. The *Journal* of the American Medical Association states that the matter has been taken up again and it has been found that the funds collected are inadequate for the purpose now. So the committee appeals for more donations. They can be sent to Professor Enrico Ferri at Rome. The sculptor is at work on the monument which will be unveiled at Verona in the spring of 1921.

ERIC DOOLITTLE, professor of astronomy in the University of Pennsylvania and director of the Flower Observatory died on September 21, from heart disease at the age of fifty years. Professor Doolittle succeeded his father the late Charles L. Doolittle in the directorship of the Flower Observatory in 1915.

SAMUEL SHELDON, for thirty-one years professor of physics and electrical engineering at the Brooklyn Polytechnic Institute, died on September 4 at the age of fifty-eight years.

MR. ARTHUR JACKSON ELLIS, geologist in the Water Resources Branch of the U. S. Geological Survey, died on July 22, 1920.

THE death of Charles N. Forbes, for twelve years curator of botany on the staff of the Bishop Museum, occurred on August 8.

DR. GEORGE MOREWOOD LEFFERTS, a retired specialist in throat diseases, emeritus professor of the College of Physicians and Surgeons, Columbia University, where he was a member of the faculty from 1874 to 1904, died on September 21 at the age of seventy-four years.

KARL HERMANN STRUVE, director of the Berlin-Babelsberg Observatory, and professor of astronomy in the Berlin University, died on August 12.

WE learn from *The Observatory* of the death of Mrs. Frametta Wilson, who was one of the five women pioneers admitted as fellows of the Royal Astronomical Society in 1916, and was later elected a member of the council. Mrs. Wilson had been awarded the "Edward C. Pickering Astronomical Fellowship for Women" for the college year 1920–21 had been assigned by the Harvard College Observatory.

DR. J. PIERRE MORAT, formerly professor of physiology at the Lyons medical faculty, has died at the age of seventy-five years.

THE British Thomson-Houston Company has decided to establish two scholarships, one of which will be allotted to Cambridge. It proposes to select from the engineering graduates of that university who have worked with the firm for not less than six months a scholar who will be sent to their American associates, the General Electric Company. The company proposes to allow for the student's expenses for one year an equivalent of $1,800 dollars. After a year's study in America he will be expected to return to the British company.

COLUMBIA UNIVERSITY, beginning with the autumn term, will offer in cooperation with Rutgers College and the State University of New Jersey a regular four years' course in agriculture leading to the degree of bachelor of science. The first two years will be given chiefly at Columbia and the second two years at Rutgers. The student who completes the course will receive his degree from Rutgers College. The requirements for admission are the same as those for Columbia College. Students are urged to spend at least a year on a well organized farm before entering Columbia. Working on farms during summer vacations approximates satisfactory farm experience.

UNIVERSITY AND EDUCATIONAL NEWS

THE first section of the new engineering shops which are being constructed at Camp Randall for the College of Engineering of the University of Wisconsin will be ready for occupancy about the first of the second semester. This building is the first step towards moving some of the engineering work to Camp Randall and it will relieve the overcrowded conditions resulting from the heavy enrollment in the College of Engineering since the close of the war.

DR. WILLIBALD WENIGER, formerly head of the department of physics, who left six years ago to engage in research work at the Nela Research laboratory of the National Electric Lamp Division of the General Electric Company, Cleveland, Ohio, has returned to his former position in the Oregon Agricultural College. At this institution Dr. Floyd E. Rowland, assistant professor of chemistry in the University of Kansas, has been appointed head of the department of chemical engineering, and Dr. Nathan Fasten, of the University of Washington, has been appointed associate professor of zoology. Dr. S. M. Zeller, assistant professor of plant pathology has been promoted to be associate professor in charge of orchard disease investigation.

DR. PHILIP HADLEY, formerly professor of bacteriology at the Rhode Island State College and biologist at the Agricultural Experiment Station, has received appointment on the faculty of the department of bacteriology and hygiene, school of medicine, University of Michigan.

DR. VERNON K. KRIEBLE, assistant professor of chemistry at McGill University, succeeds Dr. R. C. Riggs as Scoville professor of chemistry at Trinity College, Hartford, Conn.

DISCUSSION AND CORRESPONDENCE

ELECTRICITY AND GRAVITATION

THE action of gravitation on light is generally regarded as a continuous process but if we consider a ray of light as the limit of a chain of rectilinear rays for each of which the velocity has its upper limit value c, we can regard the gravitational action on the ray as built up of a succession of impulses, each of which changes the direction of the ray. To obtain a definite picture of this action, let us imagine the æther to be built up of electrical doublets travelling along straight lines with velocity c and sometimes colliding with one another. A collision in which the doublets break up and their constituents secure new partners leads to a temporary manifestation of free electric charge. For simplicity we shall suppose that this type of collision takes place only at points where matter is present and that such collisions occur continually so that the manifestation of free electric charge is permanent[1] and approximately steady. At a point not occupied by matter a collision may be supposed to result simply in a change in the direction of motion of the doublets. It is possible, however, that collisions are all of the first type. The elementary type of electromagnetic field is one in which a doublet breaks up into positive and negative constituents which fly away in different directions with the velocity c. The field of an electric charge moving with a velocity less than c can apparently be built up from such elementary fields by superposition and so the assumption of the fundamental character of the elementary field seems legitimate.

[1] We imagine one component of a doublet to be momentarily separated from its fellow, when another doubtlet comes along the lonely charge secures a new mate and leaves another charge all alone, this charge behaves in a similar manner when it encounters another doublet and so on. In what follows we really consider collisions between doublets and free electric charges.

From the elementary fields it is possible to build up a type of field in which the electric charge associated with an electric pole fluctuates owing to the fact that the constituents of a doublet are in the neighbourhood of the pole at slightly different times. We shall assume that the electric action between two poles depends on the instantaneous values of the charges and shall endeavor to estimate the effect of the fluctuations. Let us assume that the total number of doublets which break up at an electric pole per unit time is proportional to the mass associated with the pole. This number will also be supposed to be the number of doublets which are created from the constituents of those which break up. Among the doublets which arrive at the second pole B there may be some that have come from A. Let us suppose in the first place that there is no gravitational shielding, then it seems reasonable to assume that the percentage of B's doublets which have come directly from A is proportional to the number which leave A and so is per unit time, proportional to the mass of A. The number of doublets which pass directly from A to B per unit time is thus proportional to the product of the masses of A and B. The doublets themselves will be supposed to be so small that the emission of the different doublets and the arrival of others may all be regarded as independent events. At an instant of time t when a doublet from A is arriving at B the charge on B may be then regarded as equal to $e' + f(t)$ when the charge on A at the earlier time $t - (AB/c)$ was $e - f(t)$. The function $f(t)$ is supposed to have a mean value equal to zero so that e and e' may be regarded as the mean charges associated with A and B respectively. The above expressions for the charges are supposed to hold only for the very short periods of time when the particular doublet under consideration is in the neighborhoods of B and A, at other times the values of the charges are governed by the presence of other doublets.

The mean value of the electric force between A and B over a small period of time, which is

very large compared with the time during which a particular doublet is in the neighborhood of B, is proportional to $ee' - k^2$ where k^2 is the mean value of the square of $f(t)$ for all the doublets which pass from A to B and arrive at B in this interval. In accordance with our previous hypothesis it seems reasonable to conclude that k^2 is proportional to the product of the masses of A and B.

If in the interval of time from t to $t + dt$, no doublets arrive at B while a doublet left A in the corresponding interval $t - (AB/c)$ to $t + dt - (AB/c)$ it is clear that the mean value of the electrical force between A and B in this interval depends on ee' and there is no gravitational action. Other cases may be considered in a similar way and it is clear that the gravitational action depends only on the doublets which go directly from A to B. The action of B on A depends likewise on the doublets which go directly from B to A.

The present theory indicates that there may be a slight screening effect when a third body C is interposed between two bodies A and B, for C may be supposed to receive some of the doublets which would ordinarily go directly from A to B or vice-versa. The recent work of Nipher[2] and Majorana[3] thus becomes of additional theoretical interest when it is considered in the light of the present theory.

Gravitational action may be slightly modified, too, by collisions between doublets travelling with velocity c. In this connection it may be worth while to point out that if P and Q are two doublets travelling along different straight lines with velocity c, then after a certain instant it is possible for a particle travelling with velocity c to meet first one doublet, say P, and then Q but not for such a particle to meet first Q and then P. A series of moving doublets may thus be arranged in a definite order; something which happens to one doublet may affect those which come later in the series but not those which come earlier. This result may have some connection with the damping of oscillations in the emission of light. A more imperfect form of the present electrical theory of gravitation has already been published in *Proc. London Math. Soc.*, T. 18 (1919), p. 95, and in the *Messenger of Mathematics*, T. 48, p. 55. The possibility of a connection with the work of Einstein and Majorana has not been pointed out previously. The present theory seems to be free from the objections raised against the older electrical thory of gravitation (see O. W. Richardson, "The Electron Theory of Matter," p. 596), there may, however, be some other fatal objections to it.

H. Bateman

[2] Science, September 21 (1917).

[3] *Phil. Mag.*, T. 39, May (1920), p. 488.

PROTOZOA IN SAWDUST FOR CLASS WORK

In studying the method of excreta disposal by compositing night-soil with sawdust, the chance observation was made that microscopic examination of old sawdust piles revealed the presence of *Euglypha* cysts. Samples of sawdust were used for experimental culture of hookworm eggs and it was observed that the cultures showed profuse contamination with amœba, flagellates, ciliates, and free living nematodes. Samples from old sawdust piles were then moistened and incubated with the result that numerous specimens of protozoa and free nematodes were found.

The sawdust used was chiefly from southern pine.

This note is published with the thought that it may be of practical service to teachers in providing material for class work.

C. W. Stiles

U. S. Public Health Service

CONCERNING DIASTROPHISM

Two papers have appeared during the current year which once again bring before American geologists the vexed question of systemic boundaries. In the first Böse[1] concludes that the ammonites found at Tularosa, New Mexico, 200 feet above the base of the Abo sandstone, are of Carboniferous age. This inter-

[1] Böse, E., *Am. Jour. Sci.*, Vol. 49, pp. 51–60, January, 1920.

pretation involves considering the break in sedimentation at the bottom of the Manzano group of that region, of which the Abo is the lowest formation, as having occurred during so-called Pennsylvanian time, and would place the boundary between the Pennsylvanian and the Permian at some undetermined horizon within the Manzano group of conformable formations, as Lee[2] has pointed out. I would not be in the least surprised if this last is not the true interpretation of the facts. It is just what would be expected by any one disposed to doubt the validity of the so-called diastrophic method of correlation, and, if I mistake not, is exactly what occurs in the Appalachian region.

The second paper to which I refer is one by Twenhofel[3] who concludes that all of the Cretaceous below the Benton in Kansas should be referred to the Comanchean, and that the Cheyenne-Kiowa-Medicine sequence of southern and the Mentor-Dakota sequence of central Kansas are the equivalents of the Washita division of the Texas Cretaceous, although it is conceded that the Washita faunas and floras are probably of Cenomanian age and therefore Upper Cretaceous according to European chronology.

Without discussing the merits of these conclusions in this place, I wish to call attention to the more general question involved, which is clearly recognized by Lee in connection with the Manzano group, and which is discussed at some length by Twenhofel in connection with the Kansas Cretaceous, namely as to what are the criteria of systematic boundaries.

I can see no fundamental objection to using such terms as Comanchean as a convenient group or descriptive term any more than in using such terms as Mississippian or Pennsylvanian, disregarding even that Mississippian in its original significance was Cambrian, but to use Comanchean as the equivalent of the European Lower Cretaceous, which it is not in either its lower or upper limits, and thus to bring about a situation where Lower Cretaceous in Europe, Asia, Africa, Australia, and South America means Lower Cretaceous, whereas Lower Cretaceous in the United States means early Upper Cretaceous, appears to me most reprehensible.

American geological literature has been deluged, one might almost say diluted, with diastrophism during the last decade, and philosophers, scientific as well as political, stand on every street corner. Whether there is any world wide periodicity in movements of the strand line as Suess and Chamberlin contend, or whether each region has its individual history as Willis contends, I do not know, although what we know of geological history is all in favor of the latter supposition. I should imagine that sometimes one and sometimes the other might be true, depending entirely on the causes that affect the relative positions of the land and sea in specific cases.

I certainly can see no basis for the "law of periodicity" that Willis writes about beyond the partial fulfillment of Newberry's much older conception of cycles of sedimentation, which are no more comparable in chronologic magnitude than are the life cycles of organisms.

If American geology is to finally adopt diastrophism as the ultimate basis for the delimitation of the more important time boundaries, and it is already clear that the geologists of no other nation are likely to follow our lead, we shall have to devise a different terminology for each continent, or even for different parts of the same continent. For example on our Pacific coast there were Triassic floodings that have been successfully correlated by Smith on the basis of their ammonite faunas with those of the Mediterranean region of the old world. On our Atlantic coast there are no traces of any corresponding events. Exactly similar conditions prevailed in the two general regions during the Jurassic. Lower Cretaceous marine sediments are confined to the southern and western parts of North America, and one might start at the bottom of the geological column and point out very many similar contrasts.

The two continents whose geology has been

[2] Lee, W. T., *Idem*, pp. 323–326, May, 1920.

[3] Twenhofel, W. H., *Idem*, pp. 281–297, April, 1920.

longest studied and is best known, namely Europe and North America, show the greatest amount of divergence even in formations as recent and well preserved as those of the Tertiary, and there are the most striking contrasts in the geological history of Mediterranean as compared with central and northern Europe. The same situation exists upon all of the other continents.

Even supposing that changes in relative level have been due to general causes such as the periodic sinking of ocean basins and the filling of oceans by sediments,[4] which has not been demonstrated and is directly opposed by what we know of geological history, the results as reflected in those chapters of geological history available for our study, would vary with the initial attitude of the land in a particular area, its location with respect to the position of the antecedent sea level, etc. A striking illustration of this is furnished by a comparison of the not very remote regions of Belgium and the Paris basin, or even of the center and periphery of the latter during the Cretaceous and Tertiary.

The question resolves itself into whether geological classification in its major outlines shall be local, that is, provincial and nationalistic, or whether it shall be understood and capable of application in any country. I am one of those reactionaries who believe that classification is a means and not an end, and that, however imperfect the scheme may be as devised for the region first and longest studied, namely Europe, the classic names with the historic perspective that goes with them, should be adhered to in this country.

Classifications are all purely artificial, they are the medium of exchange, and geological time boundaries are no more physical facts than are political boundaries, even though it may be difficult to avoid thinking of them as though they are entities. Probably the best ultimate solution would be to have a universal (international) time scale and a local sedimentary scale as we now have for our formational units. After all the best classifications, whether of geological time, systems of rocks, organisms or igneous rocks, are those most easily understood and used, those in which facts and relationships are not obscured or wholly disguised by names.

[4] A simple quantitative computation will show how trifling would be the maximum change in sea level from the latter.

Time is continuous, boundaries are always subjective, and the Permian, Triassic, Lower Carboniferous or Lower Cretaceous are to me as essential to clear thinking and the interchange of ideas among nations as are the minutes, hours, days and weeks of current chronology, however illogical these might seem in sidereal astronomy.

The problem of correlation would be immensely simplified if diastrophism could be demonstrated to be of universal application. This is I believe the reason it has so appealed to many, but like its prototype devised by Werner it is altogether too simple to be true.

It seems to me that the most reliable basis of correlation must remain paleontologic until such time as it can be shown that changes of relative elevations are due to changes of sea level, and if this be true there is a disturbing factor in attempting to settle the relative merits of homotaxis versus synchroneity. I have a feeling, however, that homotaxis, although theoretically true, has been greatly overestimated in its bearing upon our interpretations of geological history where we do not have continuous sedimentation to deal with.

Paleontologic correlation, it should be needless to remark, rests ultimately upon the synthesis of all classes of organic evidence, not merely upon invertebrates, vertebrates or plants. How little this truism is observed in practise and to what an extent geological thought is still permeated by Cuvier's cataclysmal philosophy can be appreciated by reading any recent discussions of the boundary between the Devonian and Carboniferous, the Triassic and Jurassic, the Jurassic and Lower Cretaceous, or the Upper Cretaceous and Tertiary. Accepting the doctrine of evolution for life and of uniformitarianism for earth history, the average stratigraphic paleontologist seems determined to prove cataclysms and special creation.

The ultimate solution, or at least the one that is most to be desired, it seems to me, will be a universal time scale which shall have its basis in paleontology and shall adhere to the classic names, and in which the cycles and epicycles of diastrophism will be regarded as probably the most useful criteria for delimiting formational or larger sedimentary units, but never *per se* as criteria for the division of geological time.

Edward W. Berry
The Johns Hopkins University

SPECIAL ARTICLES

THE INFLUENCE OF DRY VERSUS FRESH GREEN PLANT TISSUE ON CALCIUM ASSIMILATION

In early work on mineral metabolism with both the cow and the goat we showed that milking animals, receiving grains and dry oat straw as a roughage, are brought into a decided negative calcium balance. In the case of a goat the interesting observation was made that after a period of negative calcium balance, followed by access to fresh green grass, a positive calcium balance was observed, using the same ration as was used in the period preceding the access to green plant tissue. In extensive experiments Forbes and associates and Meigs and his associates have observed negative calcium balances with milking cows receiving rations liberally supplied with calcium. The rations used were from air *dried* materials, supplemented in some cases with silage. The striking feature of all the data obtained in these experiments was the large amount of fecal calcium, indicating a failure to assimilate satisfactorily this base.

In these our preliminary experiments, we have used milking goats. They have readily been brought into negative calcium balance on a ration consisting of air dried grains and air dried straw, with more calcium excreted in the fecal residue than was ingested with the ration. When the *dry* cereal straw was displaced by an equivalent in dry matter of fresh *green* material, with no increase in the total calcium intake, the negative calcium balance was reduced in one animal from 1.6–2.7 grams CaO to .6 CaO per day. With another animal it was reduced from 1.5–2.5 grams CaO per day to .3–.8 gram per day. On the low calcium intake of 8 to 9 grams of CaO per week we could not expect a positive calcium balance to ensue, but this remarkable difference in the amount of calcium assimilated from the two rations we believe, has very great significance.

These changes in calcium assimilation are not to be attributed to variation in water intake or to unavailability of the calcium. Apparently there is something having its source in fresh green materials, which controls or assists calcium assimilation. It is suggested that under the extra strain of rapid growth or milk production not enough calcium can be assimilated for the liberal uses made of this element, unless there is present an abundance of calcium in the diet as well as an abundance of this something that assists calcium assimilation. Possibly we are dealing with the anti-rachitic vitamine, assumed as the fourth food accessory factor. In any case this problem touches growth, milk production and egg production. In the case of nursing women the relation of diet to a positive or negative calcium balance and to dental conditions will assume new aspects.

The supposition that we are dealing with something influencing calcium assimilation and which is more abundant in green than in dried plant tissue and consequently variable with the season's milk, would explain the variations in the seasonal frequency of rickets, as observed and commented upon by Hess.

Our data are not yet inclusive enough to indicate definitely the factors involved in this problem, yet we have been sufficiently impressed with the constancy of the observations made that it appears desirable to reemphasize this relation to mineral metabolism which we anticipated some years ago and expressed in an earlier publication.

E. B. Hart,
H. Steenbock,
C. A. Hoppert

THE AMERICAN CHEMICAL SOCIETY. IX

DYE SECTION

Charles L. Reese, *chairman*

R. Norris Shreve, *secretary*

Dye patents of the chemical foundation, incorporated: S. A. Tucker. The paper deals with the classification of the dye patents owned by the company which forms the largest division of any class of its patents, and covers practically all classes of dyes. The method followed enables one to locate any patent either by the chemical constitution of the dye or its application. Patents actually licensed either by the Chemical Foundation or the Federal Trade commission are discussed at considerable length. A list of patents of which the Schultz number is known but which have not yet been licensed is given. The advantages in the form of license as issued by the Chemical Foundation are pointed out and the influence which the company may have on the American chemical industry is discussed.

Dyes for photographic sensitizing: W. F. Meggers and F. T. Stimson. Illustrations are given of the photographic impression made by a continuous spectrum upon Seed's 23 plates before and after treating with typical photo-sensitizing dyes. Spectral transmission curves of the dye solutions and spectral sensitivity curves of photographic plates stained with the dyes are shown. Examples of the use of color sensitive photographic plates in aerial photography are exhibited and the importance of photo-sensitizing dyes to future developments in photography is emphasized.

Anthranilic acid, tests and purity of the commercial product: J. F. Ragsdale. The melting point of anthranilic acid is found to be higher than that usually given in the literature. Since decomposition occurs on melting, certain precautions must be observed in taking the melting point. Various methods for determining the anthranilic content of the commercial product are discussed, and diazotation with standard nitrite solution is recommended. Several methods for standardizing the nitrite solution have been tried, and advantages and disadvantages of each are pointed out.

Ortho chlor para toluene sodium sulfonate—purity and tests of the commercial product: L. A. Watt. Ortho chlor para toluene sulfonate is one of the dyestuff intermediates now produced in quantity in this country. The impurities encountered in the commercial product are enumerated and a procedure for their detection and determination based on the relative solubilities in alcohol is suggested. Data obtained from the examination of both low grade and typical commercial products are given.

Uses of formic and oxalic acids in the dyeing industry: Lancelot W. Andrews. For the acidification of dye baths, an acid should be selected having intrinsic strength enough to cause full utilization of the dye and fixation on the textile, but not having so great intrinsic strength as to injure the fabric. The intrinsic strength of the acids are determined by their electro-dissociation coefficients. It is shown by both theory and practise that formic acid is particularly well suited for use of the dyer and that its high dissociation constant and its low molecular weight, render its employment thoroughly economical. Formic acid offers the following advantages as compared with the mineral acids, or with acetic and other available organic acids: (1) No tendering of the textile, (2) greater evenness of dyeing, (3) better exhaustion of the dye, (4) better fixation on the textile, (5) brighter color, (6) better penetration, (7) economy. American manufacturers are now able to supply both formic and oxalic acids, and the mordant salts of these acids, with Al, Cr, Sn, Sb, etc.

Synthetic dyes as applied to chemico-therapy and microscopy: Geo. Heyl. Part 1. Medicinal Dyestuffs: (*A*) Theory of action. (*B*) Synthesis and pharmacological effect. (C) Classification of medical dyestuffs: (*a*) Eutherapeutic and dytherapeutics; (*b*) Dyestuff specifics (salvarsan, acriflavine, etc.); (*c*) External dyestuff antiseptic; (*d*) Dytherapeutics and parasiticidal action; Trypan blue, trypan red, naga red, methylene blue, etc.; (*e*) Neutral dyes and nerve cells; Methylene azur, eosine-azurs, etc., and neutral red. (D) General outline of preparation. Part 2. Microscopic Stains: (*A*) Theory of action (Ehrlich-Witt). (*B*) Classification. (*C*) Standardization.

Dye research: Robert E. Rose. Research we must have—not a mere checking up of receipts, not a mere search for information which is known to others. We must graduate to real research, that is, enter the entirely unknown. Much of this type of research must be done in the universities, but under conditions of close cooperation with the

industries. To do this latter, the industries must lose their intense secrecy, and open their doors—with proper safeguards—to the university men. Raw products, money, commercial organization, industrial chemists, all these we may have and yet fail if we have not real research.

The hydrogen exponent classification of indicators and some of its applications: I. M. Bernstein. (1) Definitions of terms used. (2) Determination of indicator constants: (*A*) Approximation method of Salessky; (*B*) colorimetric method; (*C*) Bjerrum's method. (3) Classification of indicators according to exponents: (*A*) Chart of same showing color changes; (*B*) comparison with Glaser's classification. (4) Application of classification of volumetric analysis: (*A*) Neutralization curves. (*B*) Selection and concentration of correct indicator. (*C*) Preparation of new indicators. (5) Application of classification to biological technic: (*A*) Determination of hydrogen ion concentration; (*B*) the selection of correct indicator for physiological solutions.

The analysis of aromatic nitro compounds by means of titanous chloride: F. L. English. The procedure for the analysis of aromatic nitro-compounds as recommended by Knecht and Hibbert (see "New Reduction Methods in Volumetric Analysis") has been modified and successfully applied to numerous typical nitro-compounds of the benzene series among which are *m* and *p*-nitranilines, *o*- and *p*-nitrophenols, *o*- and *m*-nitro-*p*-toluidines, two of the nitro-salicylic acid isomers, dinitrobenzene, toluene and xylene, trinitrotoluene and picric acid. The experimental figures given show the method to be accurate to about 0.1 per cent., total error. Results are given also to prove the inapplicability of the method in its present form to nitrochlor derivatives such as *o*- and *p*-nitrochlorbenzene and dinitrochlorbenzene, under-reduction resulting in the first two cases and over-reduction, probably at the expense of the chlorine atom, in the last. When the chlorine is in the side-chain, however, the reaction proceeds more nearly quantitatively as illustrated by *p*-nitrobenzyl chloride and dinitroxylyl dichloride (1–3–CH_2Cl–2–4–NO_2 benzene). The analytical procedure, as well as the preparation, standarization and storage of the volumetric solutions, is described in detail.

Some physical constants of pure aniline: C. L. Knowles. A sample of aniline was carefully purified by conversion to the oxalate, regeneration and repeated vacuum distillation. Physical constants were determined immediately without undue exposure to the air. Freezing and boiling point determinations were recorded by means of a recently standardized platinum resistance thermometer. The constants found are as follows:

Freezing point — 6.24° C.
Boiling point 184.32–184.39° C. at 760 mm.
Specific gravity 15/15 1.0268.
Refractive index 20° C. 1.5850.

On exposure to the air aniline absorbs moisture very rapidly, taking up 2.4 per cent H_2O in 46 hours reducing the freezing point nearly 2° C. Indications are that the freezing point is the best criterion of purity which may be calculated by substitution in the following formula, (t) being the observed freezing point and (x) the per cent. aniline in the sample. $X = 108.79 + 1.41\ t$.

The absorption spectra of the nitric esters of glycerol: E. Q. Adams.

Tetramethylquinolines: L. A. Mikeska.

Naphthalene sulfonic acids. Some difficult soluble salts of naphthalene sulfonic acids: J. A. Ambler.

A method for the qualitative detection of some naphthalene sulfonic acids: J. A. Ambler.

Synthesis of s-Xylidine: H. L. Haller.

Alkali fusions. II. The fusion of sodium benzene disulfonate with sodium hydroxide for the production of resorcinol: Max Phillips and H. D. Gibbs.

A synthesis of thymol from p. cymene: Max Phillips and H. D. Gibbs.

The vapor pressure of phthalic anhydride: K. P. Monroe.

A new source of furfural and an investigation of the preparation and properties of "furfural green": K. P. Monroe.

The absorption spectra of the nitric esters of glycerol: Elliot Quincy Adams. Hepworth (*Jour. Chem. Soc.*, 115, 840–47 (1919)), from a study of the absorption spectra of the nitric esters of glycerol, concludes "(6) There does not appear to be any numerical proportionality between the number of hydrogen atoms of the hydroxyl groups displaced by nitro-groups and the degree of absorption for any particular dilution." A critical study of the results of Will (Ber. 41, 1107–23 (1908)), which have been accepted by Hepworth, indicates that his designations α- and β- for the mononitrates should be interchanged. Each nitrate radicle has an absorptive effect de-

pendent on its location in the molecule, but independent of the presence of other nitrate radicles.

Tetra methyl quinolines: L. A. Mikeska and E. Q. Adams. The dicyanines—a series of photosensensitizing dyes extending the sensitiveness of the photographic plate farther into the infra-red than any other known substances—requires as intermediates the quaternary halides of 2, 4 dimethylquinoline and 2, 4, 6-trimethylquinoline. These bases are made by condensing with paraldehyde and acetone—by a synthesis similar to that of Shraup—respectively aniline and *p*-toluidine. The xylidines give by this condensation tetramethylquinolines, of which only one has heretofore been prepared (and incorrectly named). Three of the six possible isomeric tetramethyquinolines have been prepared: 2, 4, 5, 7-; m.p. 59°; 2, 4, 6, 8-; m.p. 86° and 2, 4, 5, 8-. The preparation of the others is in progress.

Naphthalene sulphonic acids. I. Some difficultly soluble salts of certain naphthalene sulphonic acids: Joseph A. Ambler. The preparation and properties of the alpha naphthylamine salts, and of the beta naphthylamine salts of the naphthalene alpha, beta, 1–5, 1–6, 2–6, and 2–7 sulphonic acids, and of ferrous naphthalene beta sulphonate are given. Crystallographic-optical properties as determined by E. T. Wherry are included. These salts are all difficultly soluble in water and possess characteristic optical properties.

Naphthalene sulphonic acids. II. A method for the qualitative determination of some of the naphthalene sulphonic acids: Joseph A. Ambler and Edgar T. Wherry. It was found that the properties of the salts described in the preceding article can be used for a qualitative test for the naphthalene alpha, beta, 1–5, 1–6, 2–6, and 2–7 sulphonic acids. Naphthalene beta sulphonic acid is detected with ferrous chloride; the 1–5 sulphonic acid, with alpha naphthylamine hydrochloride in boiling water; the 2–6 sulphonic acid, with beta naphthylamine hydrochloride in boiling water; the alpha acid by the solubility of its beta naphthylamine salt in hot acetone; the 1–6 and 2–7 sulphonic acids, by the optical properties of their beta naphthylamine salts.

Benzene disulfonic acid from benzene monosulfonic acid: C. E. Senseman. The well-dried barium salt of benzene monosulfonic acid is treated with sulfuric acid varying in concentration from 93–98 per cent. The temperatures for the various runs are 220°, 250° and 280°. The quantities of acid used range from 1½–8 mols to one mol of the free monosulfonic acid. The duration of the various experiments was from 8–10 hours. Vanadium pentoxide and sodium sulphate were tried out as catalysts. The progress of the reaction was determined in each case by removing a sample at the end of each hour and analyzing for the disulfonic acid. Without the use of a catalyst the highest yield obtained was 93.3 per cent. A yield of 98.2 per cent. was obtained when sodium sulphate was used as a catalyst.

Synthesis of s-xylidine: Herbert L. Haller and Elliot Q. Adams. S-xylidine was synthesized (1) from mesitylene—which was oxidized to mesitylenic acid; changed to the amide; and finally converted by means of Hofmann's reaction to *s*-xylidine; (2) from *m*-4 xylidine by successive acetylation, nitration, saponification and deamination; and reduction. In the latter procedure the saponification and deamination were carried out in one step. Acetyl derivatives of the xylidine obtained by the two methods were compared, and their melting points found to be the same, 139.6°–140.2° (corr.). The optical properties also were found by Dr. E. T. Wherry to be identical.

Alkali fusions. II. The fusion of sodium benzene m-disulphonate with sodium hydroxide for the production of resorcinol: Max Phillips and H. D. Gibbs. Although the process of making resorcinol by the fusion of sodium benzene *m*-disulphonate with sodium hydroxide has been in use for a considerable number of years, nevertheless, there appears to be no agreement as to what are the proper conditions for conducting the fusion in order to obtain the highest yield of resorcinol. Using an apparatus especially suited for this work, a study was undertaken for the purpose of ascertaining the optimum conditions for conducting the alkali fusion. The problem resolved itself into a study of the four following factors: (1) Ratio of sodium hydroxide to the sodium benzene *m*-disulphonate; (2) the proper fusion period; (3) the proper fusion temperature; (4) effect of the addition of water to the sodium hydroxide upon the yield of resorcinol. The results obtained indicate that 310° is the best fusion temperature, two hours the best fusion period, 14 to 16 moles sodium hydroxide to one mole sodium benzene *m*-disulphonate the best fusion mixture, and that water when present in the fusion mixture tends to reduce the yield of resorcinol.

A synthesis of thymol from p-cymene: Max Phillips and H. D. Gibbs. p-cymene, an aromatic hydrocarbon, although long known to chemists,

has recently attracted considerable attention because of the fact that it is obtained in rather large quantity as a by-product in the spruce pulp industry. Thymol, which is of considerable commercial importance and which bears the same relation to *p*-cymene as does phenol to benzene, can not be obtained from *p*-cymene by the ordinary methods of getting a phenol from its corresponding hydrocarbon. However, by using the following rather indirect method the synthesis of thymol was accomplished: *p*-cymene was nitrated and the compound with the nitro group in the position ortho to the methyl group was obtained. This compound was reduced to the corresponding amino *p*-cymene or cymidine, which when sulphonated gave cymidine sulphonic acid, the sulphonic group entering the position ortho to the isopropyl group. The amino group of cymidine sulphonic acid was then removed through diazotization and subsequent reduction with alcohol and copper powder. The cymene sulphonic acid thus obtained was converted into its sodium salt and the latter when fused with sodium hydroxide was converted into thymol.

The vapor pressure of phthalic anhydride: K. P. MONROE.

The preparation of furfural: K. P. MONROE. Corn-cob adhesive prepared according to the method of La Forge and Hudson (*J. Ind. Eng. Chem.*, 10 (1918, 925) by extracting corn-cobs with water under pressure at 150° C. is an excellent source for furfural, since the gums so obtained are rich in pentosan and yield 26 per cent. of pure furfural. The essential improvements over the previously published methods of obtaining furfural from pentosan containing material are (1) removal of furfural from the reaction mixture by a rapid current of steam during the hydrolysis by 25 per cent. H_2SO_4; (2) separation of furfural from the dilute aqueous solution which constitutes the distillate by distillation with the acid of a fractionating column. Uses for furfural in the industries and arts are outlined; among these are the preparation of: hard resins similar to the well-known "Bakelite," soluble resins which may find application in the varnish trade, a series of dyes which may be obtained by condensation with various coal-tar products.

The vapor pressure of phthalic anhydride: K. P. MONROE. The vapor pressure of phthalic anhydride was determined by the static isoteniscope method of Smith and Menzies (*J. Am. Chem. Soc.*, 32 (1910), 1412–59). The following equation, of the type obtained by integration of the Clausius-Clapeyron equation with simplifying assumptions, was found to express the results:

$$\log_{10} p = 7.94234 - \frac{2823.5}{T} \tag{1}$$

where p = vapor pressure in millimeters of mercury and T = absolute temperature. The molar latent heat of vaporization was calculated to be 12,910 colories, while the value 13.6 was obtained for the entropy of vaporization divided by R (the gas constant) at the temperature (near 218°) at which the concentration of vapor is 0.00507 mole per liter. According to the criterion of Hildebrand (*J. Am. Chem. Soc.*, 37 (1915), 970), this indicates phthalic anhydride to be a *normal* liquid.

The present independence of American synthetic dyes and how it was accomplished: ROBERT E. HUSSEY. Prior to the war all of the biological dyestuffs used in the bacteriological laboratories and in the laboratories of public health came from Germany. The two chief difficulties upon the cessation of imports that confronted the American manufacturer were lack of raw supplies and lack of accurate information as to their manufacture. All of these dyes must be absolutely uniform and standardized as certain arbitrary amounts are used in certain dilution to attain specific results. The army had to be supplied. Quantity production took place and, after much experimentation, this experience has now made it possible to supply scientific dyes equal and in some cases, superior to those formerly imported. Investigators should mention that American dyes were used to obtain their result for by this method proper encouragement to this industry would be given.

CHARLES L. PARSONS,
Secretary

(*To be continued*)

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, OCTOBER 8, 1920

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE NAPLES ZOOLOGICAL STATION

ON a recent visit to Naples the writer discussed with Professor Filippo Bottazzi details of the war management of the Naples Zoological Station and its proposed future disposition—a subject that will be of interest to the readers of SCIENCE.

In the train of events following May, 1815, R. Dohrn, director of the station, and all the German personnel, departed. The zoological station was taken over by the Italian government. The management was placed under the administration of a special commission composed of Professor F. S. Monticelli, of the University of Naples; Professor L. De Marchi, of the University of Padua, and Comm. G. Biraghi, department chief of the Ministry of Education. Professor Monticelli was made president of the commission. This commission then appointed Professor U. Pierantoni, of the University of Naples, director of the zoological section of the station; Professor F. Bottazzi, of the University of Naples, director of the physiological section, and some other assistants.

By a decree May 26, 1918, the commission placed the station under the auspices of the Ministry of Education as an autonomous institution; and by another decree, June 9, 1918, the statute compiled by the commission itself was approved and now governs the administrative management of the station.

The part of the statute which concerns the scientific management of the station has aroused objections from those interested in the physiology and physiological chemistry sections, as there was a feeling that in time these two sections would be overshadowed. Without going into the details of the discussion of this portion of the statute, for the formation of which the president of the commission seems to have been solely responsible, it suffices to

say that at present the main objection is the method of appointing the scientific staff and of apportioning the appropriations among the different sections. The director of the station, who, according to the now existing statute, must be a zoologist, has sole control of the recommendation for the appointment and discharge of the entire scientific staff, assistants, and other attendants, and also makes recommendations for the financing of the station.

The station is now—and has been since the approval of the decree by the commission, June, 1918—under the direct supervision of the Ministry of Education. This is a temporary arrangement and will continue until June, 1921.

A committee of eleven has lately been appointed to formulate a plan for the future organization of the station. Of these, three never took part, and two others were called away on urgent business after the beginning of the deliberations. Of the six who participated in the discussion, five—Professor V. Volterra (Rome), Professor P. Del Pezzo (Naples), Professor D. Carazzi (Florence), Professor F. Bottazzi (Naples), and Comm. Martini (of the Ministry of Education)—made a majority report, May, 1920, with one—Professor F. S. Monticelli—dissenting.

The committee recommend that the zoological station be an autonomous institution open to Italian and foreign investigators alike. They also recommend that the state provide an annual subsidiary for the maintenance of the station to be divided, as recommended by the commission, between the Ministry of Education, the Committee on Oceanography, and the Ministry of Agriculture, all of which are interested in the future welfare of the station.

The station would thus be of the same character as other autonomous institutions, having an organization which would presuppose its administrative and scientific autonomy; and at the same time the Italian government would support it with annual appropriations. Each contributing organization of the state would reserve a given number of tables for its investigators.

The committee also recommend that the rules and regulations now in force be retained, and changes be made only where necessary to carry out the plans as set forth in the report. The most important change is that in the statute relating to the appointment of the director of the station and the scientific personnel. The committee recommend modifications that will guarantee the stability and welfare of all the sections of the station. The scientific personnel is to be placed on the same footing as that of civil employees of the state.

The essential points of the statute recommended by the committee can be briefly stated:

1. The station is to be—as approved by the decree of May 26, 1918—an autonomous institution for the investigation of marine biology; open alike, and on the same basis, to Italians and foreigners.

2. The station is to have the full control and the use of all funds and property belonging to it as proclaimed by the municipality of Naples, July 30, 1917.

3. The sources of income are to be:

(*a*) Appropriations of the Ministry of Education.

(*b*) Appropriations of the Committee on Oceanography.

(*c*) Appropriations of the Ministry of Agriculture.

(*d*) Appropriations of the Municipality of Naples.

(*e*) Proceeds of public contributions and from Italian and foreign institutions.

(*f*) Proceeds from the fees of admission to the public aquarium.

(*g*) Proceeds from tables secured by Italians and foreigners for study.

(*h*) All other sources.

4. The station will administer its own funds.

5. The station is to have a council of administration composed thus:

(*a*) Three members appointed by the municipality of Naples. The mayor is president ex officio.

(*b*) Three members appointed by the Ministry of Education.

(*c*) Three members appointed by the Committee on Oceanography.

(*d*) One member appointed by the Ministry of Agriculture.

(*e*) The director of the station.

This council is to have charge of the financing and the administration of the station.

6. Each regular contributor will be allowed to take part in the administration of the station and, according to the rules of the statute, will be given tables in proportion to the contribution.

7. The director legally represents the station and is responsible to the council of administration.

8. The station is composed of sections of zoology, physiology, and physiological chemistry. The council of administration has the power to organize other sections within certain specifications.

9. The scientific staff is composed of the directors of the various sections of the station, the assistants, and librarian.

10. The directors of the different sections are chosen through competing examinations following the general rules governing the university competing examinations and special regulations to be fixed in the statute. From these the council of administration selects one as director of the station. The director of the station serves for three years and may be reappointed. These will constitute the scientific council. The scientific council provides for the regulation of the station and collaborates in the preparation of the budget pertaining to the financial needs of single sections.

11. The assistants and librarian will be appointed by the council of administration according to the rules to be fixed by the statute. The council of administration also has charge of the appointment of all other of the station personnel.

12. The personnel according to 10 constituting the scientific staff must devote their entire time to the work of the station. The same laws governing civil employees will apply to them.

As the writer understands it, these proposed changes will not prohibit private subscriptions for tables by either Italian or foreign institutions, and such tables may be taken as in prewar times.

Edwin B Powers

Department of Zoology,
University of Nebraska

RESOLUTIONS OF THE PAN-PACIFIC SCIENTIFIC CONFERENCE

II. Anthropology

1. *Need for Polynesian Research*

Recognizing the necessity for the immediate prosecution of anthropological research in Polynesia, this conference calls the attention of governments, patrons of research and research foundations to this important scientific need. We

Recommend that the most prompt and efficient steps be taken to record the data necessary to the understanding of man's development in the Pacific area.

2. *Facilities for Instruction and Research in Anthropology*

Since there is urgent need both for anthropological research and the training of men and women therefore, and since experience has shown the advantage of close association between the graduate departments of universities and persons and institutions carrying on anthropological investigations, this conference

Recommends the creation of centers for the study of anthropology and original research therein, such centers to be developed by the expansion of university departments or the alliance of universities with other research institutions with the result that these schools of anthropology shall combine all the essential features of a museum, a research staff and a graduate school. And, further, because of the peculiar conditions under which anthropological data must be gathered necessitating both intensive field work in circumscribed areas extending over several years, and intensive synthetic work by men who are masters in many fields, thus requiring a number of men through a period of years, we therefore recommend the establishment of research fel-

lowships for linguistic research, such endowments being provided that these fellowships will attract the best men available and provide for uninterrupted work during an adequate number of years.

8. *The Bayard Dominick Expedition*

It is evident that fuller knowledge of the history and culture of the Polynesian race is essential to the solution of the ethnologic problems of the Pacific; and also that the opportunities for obtaining information are rapidly disappearing. It is therefore gratifying to learn that Mr. Bayard Dominick has conceived a plan for ethnological studies in the Pacific on a scale not hitherto attempted and has provided funds for the initiation of this research under the guidance of Yale University and the Bishop Museum.

Resolved that the commendation of the conference be extended to Mr. Dominick for his far-sighted interest and generosity and that assurance of good will and cooperation be given him.

Ships for Bayard Dominick Expedition

The Bayard Dominick expedition of the Bishop Museum is now in the field and the successful continuation of its work depends upon obtaining a ship suitable for the navigation of waters outside of established trade routes.

The conference invites attention of the United States government to the benefits likely to result from providing this expedition with a suitable vessel.

III. Biological Science

1 *Marine Biological Survey*

The necessity for conservation of natural resources has become imperative, since, in the case of the Pacific Ocean, certain economic marine species have been exterminated and others are in peril of extinction or grave depletion. Measures for such conservation must be based on an exact knowledge of the life histories of marine organisms. Knowledge of the biological, physical and chemical phenomena of the Pacific Ocean is meager and wholly inadequate to serve as the basis for rational conservation measures; therefore be it

Resolved: (1) That the First Pan-Pacific Scientific Conference recommends that the governments of the several nations bordering on the Pacific Ocean cooperate, through their several agencies concerned in surveying and charting the sea, toward the collection, compilation and publication of data relating to the topography of the bottom, and the temperatures, salinities, acidities, currents and other physical and chemical properties of the waters of this ocean, fundamental to biological research and the improvement and conservation of the fisheries.

(2) That the Conference recommends that a comprehensive systematic biological survey of the Pacific ocean and its contained islands be prepared, with special reference to the economic fisheries problems and that the investigation be carried on in so far as possible through existing agencies, such agencies to be provided with the additional apparatus and facilities necessary, the investigation to be carried on under such cooperation as will prevent duplication of effort.

(3) That the Conference recommends that the several museums biological stations and other institutions engaged in biological investigations relating to the Pacific ocean, associate themselves for the purpose of exchanging information concerning past, current and proposed investigations, the exchange of facilities and personnel, the coordination of work and prevention of duplication in their respective activities. It is further recommended that a survey be made of the facilities afforded by the several institutions, said survey to cover material, equipment, environment and the personal qualifications of the respective staffs for supplying special information and working up material. It is further recommended that the National Research Council of Washington, D. C., be invited to undertake or arrange for such survey and that a committee of this Conference be appointed to represent the interests

of the botanical and zoological sections in this regard, the committee to be appointed by the Chairman of this conference.

(4) That the conference recommends that systematic statistics of the fisheries be collected and published annually and that such statistics be, as far as possible, uniform in character and in such detail as to methods of fishing and geographical distribution as to make them useful in fisheries administration and conservation. It is further recommended that the several governments provide for a joint commission for the arrangement of the details of such statistical compilations.

2. *Recommended Investigations in Marine Biology*

Because of the urgency or importance of certain investigations, this conference

Recommends: (1) The collection of *bottom samples from depths under* OJ *fathoms*, since these are not usually obtained by deep sea expeditions and can be readily obtained at anchorage by simple apparatus.

(2) The study of the *Brachiopod Faunas* above the 1,000 fathom line inasmuch as a knowledge of these Brachiopods supplies important evidence on the question of former land connections.

(3) A systematic and thorough study of *Pacific Ocean Algae* and of the conditions under which they occur and of the part they play in their environment; this could be obtained by means already employed for certain parts of the Pacific Ocean and would be of great scientific value.

(4) Because the Hawaiian Islands lie on the margin of the tropical seas, and therefore occupy a critical position for the study of the ecology of marine organisms, among which corals are important; and because data obtained from ecologic investigations in this locality would be of value to geologists in interpreting the conditions under which fossil faunas lived, the conference recommends a careful study of the ecology of the marine organisms of the Hawaiian Islands, and particularly a study of the corals and of the organisms associated with the corals on the reefs.

3. *Land Fauna*

The part played by living animals in the solution of many scientific problems in the Pacific is well recognized. The relationship of their present to their former areas of distribution and to that of extinct allied forms is the key to some of the geological problems; they have direct bearing upon many ethnological problems and they are the chief source of evidence upon which our ideas of evolution must be built. From a knowledge of the land fauna follow great economic advantages, such as the protection of the human race against many diseases and crops against pests.

Although in certain continental Pacific areas and some of the larger islands the land fauna is fairly well known, yet in none is our knowledge complete, and in some, such as Polynesia, it is very incomplete. The urgency for this work is great, as large areas are rapidly being swept of their native land fauna. Therefore this conference

Recommends: (1) That surveys, as complete as possible, be made of the land fauna, especially of those smaller islands in which the native fauna is fast becoming extinct, or is likely to be in the near future.

(2). That the attention of zoologists be called to recently made land areas due to volcanic activity and the importance of the study of ecological development with special reference to the appearance of animal life upon such areas.

(3) That, since land mollusks are an important group in zoogeography, recommends that material for a comparative study of the soft anatomy of land snails be obtained from all the high islands of Polynesia, Micronesia and Melanesia, and that faunistic collection be increased as far as practicable by examining islands not now known or only superficially collected over.

4. *Ornithological Survey of the Pacific*

The conference expresses its gratification at the fact that arrangements have been made by the American Museum of Natural History for the purpose of undertaking and carrying on a comprehensive and intensive ornitho-

logical survey of the islands of the Pacific Ocean, particularly those of the South Seas, and extends its thanks to those who have made provision for the expedition.

5. *Collecting Polynesian Land Flora*

Since a definite knowledge of the flora of Polynesia is absolutely essential to a proper understanding and correlation of numerous problems bearing on the life and origins of Polynesian peoples, problems of forestry, agriculture, ethnobotany, plant diseases, physiology, and ecology; since the original vegetation of some island groups is rapidly being destroyed, and since botanical exploration of Polynesia has been sporadic and in many regions incomplete, therefore the Pan-Pacific Scientific Conference

Recommends: (1) That botanical exploration of Polynesia be extended as rapidly as possible in order to assemble comprehensive collections with as complete notes as possible covering the scientific and economic aspects of Polynesian botany.

(2) That this work of exploration be carried on by existing agencies, by special botanical expeditions and by heads of non-botanical expeditions employing and supervising native collectors whenever feasible for the collection and preservation of botanical material.

(3) That material be collected in bulk—from ten to fifteen specimens of each species—with the object of distributing duplicate material to Pacific institutions and to the larger botanical centers of the world.

6. *Plant Ecology on Lava Flows*

Since new lava flows and other volcanic ejecta offer fresh terrane on the abode of life, therefore this conference

Recommends that studies be made of the stages of ecological development with special reference to the appearance of forms of plant life on new volcanic deposits following an eruption; and also of plants best suited to the speedy rehabilitation for agricultural uses of regions covered by such volcanic ejecta; and of the resistance of plants to volcanic fumes.

6. *Preservation of the Hillebrand Garden (Honolulu)*

Since the botanical garden of the late Dr. William Hillebrand, author of the Flora of the Hawaiian Islands, situated in the city of Honolulu, is one of the most remarkable gardens in the world, possessing as it does many unique and rare plants introduced into the Hawaiian Islands by Dr. Hillebrand, and since the conference believes that the preservation and perpetuation of this garden, which is threatened with destruction, would be a great benefit to botanical science, this conference recommends steps be taken to insure its preservation.

IV. Geography

1. *Topographic Maps*

The exploration of Pacific regions in many branches of science is handicapped by the almost total lack of topographic maps. There is scarcely any human activity which does not depend to a great or less degree upon a knowledge of the configuration of the land. This is especially true in such work as mining, railroad and highway extension, and maintenance, utilization of water resources of the world can not be discovered and utilized efficiently without maps.

Topographic maps of any given area should be adapted in scales, accuracy and details to the scientific and economic needs peculiar to the area.

The benefits derived from adequate topographic maps are far greater than their cost and this conference urges that plans be made for carrying on a topographic survey of the lands of the Pacific regions, and that this plan be designed to give uniformity of results. This conference commends the countries of the Pacific region for the work already done by them.

2. *Survey of the Shoreline and Coastal Waters*

A general hydrographic survey of the continental shelves extending off-shore to the one-thousand fathom curve and of the island platforms should be executed, in order to supply basic data essential to all research

work involved in the general scientific exploration of the Pacific ocean.

This survey should establish a system of horizontal and vertical control, determine shore line and adjacent topographic features in true geographic position, develop submarine relief, collect and describe the materials of the bottom, observe temperature and salinity and define vertical and horizontal movements of the water. The hydrographic bureaus of the nations of the Pacific, as now organized and operating, need only expand their equipment and extend their field to meet the requirements of this project. Closer cooperation is desirable in the interest of uniformity and to avoid duplication.

These results, in addition to their bearing upon research work, have such a great economic value to the shipping, fisheries, and other marine interests that the cost of the survey for the collection of the necessary data is relatively insignificant. It is stated in a recent publication of the United States Coast and Geodetic Survey that the vessels wrecked in the coastal waters of California, Oregon and Washington in the year 1917 on account of the incompleteness of the charts involved a loss which amounted to more than double the estimated cost of a complete hydrographic survey of those waters.

This unfinished state of the hydrographic survey along the west coast of the United States is not exceptional; few regions of the Pacific of any considerable extent have been thoroughly developed. This conference makes appreciative acknowledgement of the notable contributions made to the survey of the coastal waters of the Pacific by the several nations bordering thereon; but in view of the magnitude of the work and the length of time involved in its execution it commends this general project and urges its early execution.

3. *Use of Wireless Telegraphy in Longitude Determination*

This conference commends the use of wireless telegraphy for the improvement of determinations of the longitude of the islands in the Pacific.

4. *Magnetic Survey*

The general survey of the Pacific ocean should be continued to an early conclusion and provision made for such additional work as may be needed to determine annual and secular changes in the magnetic elements. The field of work should be extended to include the coastal waters, where the magnetic phenomena are complex, and their determination essential to many important interests.

Systematic operations under this project are a comparatively recent undertaking; but already excellent results have been obtained in the Pacific from the work of the Carnegie Institution.

The work is of immediate and vital importance to navigation, and surveying, in addition to its bearing upon the general subject of geophysics and this conference hopes that plans may be made for a complete magnetic survey of the Pacific region and that the work may be expedited.

5. *Physical Oceanography*

Oceanographic investigations yield results which constitute a basis essential for scientific exploration and research in the Pacific region, notably in meteorology, geology, botany, and biology. Moreover, such investigations are of importance to navigators in disclosing dangers to vessels sailing the ocean, and are of economic value in enabling vessels to save time and fuel in their navigation.

The present knowledge of the oceanography of the Pacific is deficient in every branch, and constitutes but a meager array of data scattered widely.

In the oceanographic investigation of the Pacific waters the configuration of the bottom should be determined, specimens of the bottom deposits collected and their thickness and stratification revealed, the physical and chemical characteristics of the water at different depths and times determined, and the horizontal and vertical circulation of the waters observed.

The field work involved in such investigations must be carried on almost entirely by the governmental hydrographic organizations

of the countries bordering on and contained within the Pacific ocean, owing to the great expense involved in creating new and special agencies, and because the governmental agencies have the personnel trained in this work. Those carrying on oceanographic surveys in the Pacific should avail themselves of the services and advice of individuals and organizations dealing with those branches of science depending upon the results of such surveys.

This conference feels that a systematic oceanographic investigation of the Pacific should be undertaken as soon as possible. The plan adopted should be designed to complete the survey of the most critical areas at an early date, and eventually the whole Pacific region.

6. *Meteorology*

Investigations in meteorology, or the physics of the atmosphere designed to lead to an accurate scientific knowledge of atmospheric phenomena are of recognized importance. Very little is known of the behavior of the upper air over the land, and still less over the ocean. The fundamental aspects of these phenomena are exhibited in their simplest manner over the greatest of oceans, the Pacific. Hence it is necessary to make meteorological observation over the Pacific for the use in studying the more complex condition over the land.

Moreover, the collection and prompt dissemination of marine meteorological data are of great benefit to humanity in carrying on its commerce and in weather forecasting which is now limited by a lack of synchronized uniform, meteorological data over great areas not within the customary track of vessels.

Observation at the place of origin of typhoons, hurricanes, larger cyclonic and anticyclonic areas, as well as the development, dissipation, oscillation, and translation of the same, are essential to successful forecasting and the study of ocean meteorology. Moreover the meteorological survey of these ocean areas has practical value; therefore the governments bordering on the Pacific ocean are invited to carefully consider these matters with a view to increasing the number of meteorological vessel and land stations within the confines of this ocean and on its borders, especially the establishment of vessel reporting stations in somewhat fixed positions. In considering these matters, it is believed that special attention should be given to increasing the number of stations in the well known "centers of action."

The Pan-Pacific Scientific Conference commends the ocean navigation companies and their masters of vessels for the valuable assistance they have rendered the meteorological services of the various stations, and urges them to further cooperate especially in the matter of transmitting their weather reports by radiograph as well as by mail.

7. *Meteorological Station on Macquarie Islands*

Since the observations made at the meteorological station on Macquarie Island resulting in improvements in the accuracy of weather forecasting, this conference expresses the hope that observations at that station, interrupted by the war, may be resumed at an early date.

8. *Meteorological Station on Mauna Loa*

In view of the fact that Mauna Loa, Island of Hawaii, the highest accessible point in the central Pacific, offers exceptional opportunities for the exploration of the upper air, it is recommended that a station of the first order be established on its summit for continuous meteorological observations.

9. *Earth Tides*

The successful operation of the Michelson earth-tide apparatus at a station in the United States of America has furnished data from which the knowledge of the physical characteristics of the interior earth has been increased, and it is desirable that earth-tide stations be established in the Pacific region at widely separated points in order to discover whether the physical characteristics vary from place to place.

This conference hopes this work will be extended.

10. *Isostatic Investigations*

Investigations in the theory of isostasy have thrown much light on the subject of deviation from the normal densities in the outer portions of the earth, which is of importance in the study of geology, and in other branches of science.

Much can be added to our knowledge of this subject of isostasy by a mathematical reduction of existing field data, following well-known methods, which would involve only slight expense.

This conference urges, in the interest of geophysical and other sciences, the early reduction of existing geodetic data and the extension of geodetic field work to those regions of the Pacific where such data are now lacking.

This conference commends the Coast and Geodetic Survey of the United States, the Trigonometric Survey of India, and the Geodetic Survey of Canada for work they have done in isostatic investigations.

(*To be continued*)

BIOPHYSICS

THE need of liaison or coordination between the different but related branches of science is coming to be felt; and indeed may soon prove as great as the need of specialization. The physiologist has long been wont to consult the anatomist about the materials with which he deals, but though his subject consists largely in the physics of living matter, his contact with the physicist has been limited and often unsatisfactory. It is usually hard for the physicist and physiologist to speak the same language. Almost at the outset of the attempt at cooperation the physicist plunges into an entanglement of mathematical formulæ into which the physiologist can not follow him and from which he can not coax him out, and negotiations have to be broken off. The biologist—especially the physiologist—ought to be better grounded in physics, and the physicist would profit much if he knew something of the behavior of living matter and the physical properties in which it so strikingly differs from inanimate matter. Physiologists, even from good laboratories, often reveal ignorance of the physical terms they use by such mistakes as calling a pair of electrodes "an electrode," or transposing the terms abscissa and ordinate. Many use the electric current without sufficient understanding of its behavior to avoid some of the pitfalls into which it may lead them. Physicists on the other hand are usually so drilled in the analysis of the behavior of inanimate matter, which best lends itself to mathematical treatment, that it is hard for their minds to cope with such things as colloids, ameboid motion of protoplasm, action currents in nerve and muscle, reflex inhibition, color sense and many other phenomena which present features peculiar to life. I have seen a physicist, attempting to reduce the nerve impulse to the laws of electrical conduction in insulated cables, greet the suggestion that one must reckon with the electro-chemical condition of the protoplasmic colloid, with the answer that this was merely to relegate the nerve impulse to the realm of things we know nothing about and therefore can not analyze, and that consequently it was better to ignore colloidal chemistry. Thus ignorance of a great field of significant knowledge led to setting aside the kernel of the whole thing. I have heard of physicists being quite incredulous when told of certain well-established facts concerning the behavior of electrical charges in colloidal matter. The physicist who might have his eyes opened and his understanding broadened by a careful examination of vital phenomena, is apt to think these things are too vague and too impossible of quantitative study to merit his notice.

Physiology has sometimes been divided into bio-chemistry and bio-physics. Most research in physiology to-day is concerned rather with the chemical side of the subject than the physical side. Physiologists have effected better coordination with chemists than with physicists. But the branches of physiology abutting on the field of physics are many, and possibly offer as great a wealth of knowl-

edge as those on the chemical side. For example there is the rich field of study concerning the permeability of cell membranes and the viscosity of protoplasm, subjects bearing intimately on the life and activities of all cells, and involving the methods of physics rather than chemistry; there is the study of stimulation and functional response in the excitable tissues, which, especially in its electrical aspects, requires much of the technique and knowledge of the physicist; there is the whole field of the special senses including physiological optics and color vision, all of which may properly be called biophysics; and there is the study of the effects of radiation of various sorts on cell structure and function. All these are large fields offering great possibilities of future development, into which the average biologist is but meagerly equipped to penetrate far without the aid of a physicist with whom he can cooperate in a state of mutual understanding.

How is the situation to be met Undoubtedly most biologists—especially physiologists—would do more effective work if they had given more time to the study of physics, but it is a question how much time they can afford to divert from biological study for this purpose. The physiologist who tries to approximate the training of the professonal physicist, will not have time to acquire the thorough knowledge of biology which he should have. The physicist who must first of all be expert in his own line, can not digress to explore the field of biology with the thoroughness necessary to see where his methods would yield a harvest of data valuable to biology and instructive to himself.

The best answer is probably to be found in cooperation between experts in the two fields. A well-trained physicist with more than average knowledge of biology, cooperating with a physiologist with a good elementary knowledge of physics, should make a team capable of doing valuable work in the field where physics and biology touch—the analysis of vital phenomena.

To this end there should be courses of instruction in biophysics adapted to bringing together the workers in the two fields. Physiology as taught in the best laboratories offers the nearest approach to this which at present exists in most universities. But in physiology the biological side strongly predominates; the physical technique taught is crude compared with that of the trained physicist, and there is little attention given to physical theory. Moreover, physiology is usually taught in medical schools, where it is made to conform to the needs of the prospective physician. Thus it is treated as an applied science rather than as a pure science; it is not primarily adapted as a preparation for research.

A course is being developed at Harvard which, it is hoped, will prove a useful step toward meeting this need. It is offered by the physics department under the designation "biophysics." Through cooperation between members of the departments of physics, zoology, botany and physiology and the Cancer Commission, it is intended that this course shall serve the students of both physics and biology, introducing to the physicists those phenomena whereby living matter shows its chief differences from all other matter, and some of those applications of physics to biology which promise to add substantially to our knowledge, and enabling the biologists to learn something of those aspects of physics which it is most important that they should know.

Alexander Forbes
Harvard Medical School

SCIENTIFIC EVENTS

THE POWER RESOURCES OF CANADA

The Canadian Commission of Conservation is issuing a series of reports upon the power resources of the Dominion, the latest being "Water Powers of British Columbia." According to a review in the *Geographical Journal* it is a large volume of over 600 pages, illustrated by maps and photographs, and it deals with the subject (so far as present knowledge goes) in an exhaustive manner. A "General Introduction" discusses the value of water as a natural resource, explaining the

complicated interrelations between the various uses—*e. g.*, for power, irrigation, navigation, fisheries, domestic supplies, etc.—drawing on the experience of the United States as well as that of Canada, and showing the need for common organization and communal supervision of the various users. A second chapter deals with "Water Power Data," and under this head are given facts showing the recent tendency, particularly marked in the United States, for the control of water-power to become concentrated in the hands of a few great and related groups of financial interests. Succeeding chapters describe the history and present position of legislative control, and most of the remaining part of the volume is devoted to the present utilization and the possibilities of water-power in the Province, and the physical conditions which determine them, viz., relief (including storage facilities) and climate. In this connection a detailed description of the physical geography of each of the river systems is given, and numerous tables of stream-flow, precipitation, and temperature. The scope of the volume is therefore wider than its title would suggest. It may be noted that the surveyed sites give a total of about 3,000,000 H.P., but although this is an advance on earlier estimates, it does not take into account the fact that very large and important areas have been only superficially surveyed or are virtually unknown, nor does it allow for storage improvements.

Another publication of the commission deals with "Power in Alberta—water, coal and natural gas." It first enumerates the water-powers of the Province, which are mainly on the Bow River above Calgary and on the Athabasca River about 150 miles above Lake Athabasca, and then discusses the relative costs and advantages of water-power and steam-power. This leads to a consideration of the coal resources of Alberta. These are enormous, and the report states that they form 87 per cent. of the coal of Canada, and to show what that means one may add that, according to Memoir 59 of the Geological Survey of Canada, the total supply of the Dominion is 1,234,000 million tons, while that of the British Isles is only 190,000 million tons. Allowance has to be made for the facts that of the Canadian total about three quarters consists of sub-bituminous coal or lignite, and that three fifths of the Alberta supply belongs to this group. Making allowance for this, it still remains true that the fuel resources of Alberta are very much greater than those of Britain. Natural gas is at present locally important, but it has an uncertain future. The report ends with a note comparing various methods for the fixation of nitrogen by electricity, a matter which will be of importance when the prairie lands need cheap artificial manures.

FUR SEALS OF THE PRIBILOF ISLANDS

The regular sealing operations at the Pribilof Islands closed for the season on August 10. The Bureau of Fisheries reports that telegraphic information is to the effect that in the current calendar year through August 10 there were taken on St. Paul Island 21,936 pelts, and on St. George Island, 4,042, a total of 25,978. Of the skins taken, 721 were from seals 7 years of age or older. The figures given are subject to slight correction when final reports are made. The fall killings, made chiefly to supply food for the natives, will add somewhat to the year's total.

The by-products plant which was operated in connection with the sealing operations on St. Paul Island produced approximately 1,800 gallons of oil and 29,000 pounds of meat or fertilizer. The operations of the plant were curtailed because of inability to secure a sufficient number of laborers from the Aleutian Islands.

During the present sealing season the bureau has utilized on St. Paul Island a number of native workmen from St. George Island. This was done without curtailing the proper take of sealskins on St. George. The transfer of the men from St. George to St. Paul was effected by the Coast Guard cutter *Bear* and the bureau's vessel *Eider*.

The Bureau of Fisheries further states that misrepresentations have recently gained currency to the effect that pelagic sealing operations are to be permitted shortly in the North

Pacific Ocean and Bering Sea. It has been alleged that the United State government is about to remove the restrictions on pelagic sealing and that great activity will soon be witnessed in the outfitting of vessels for carrying on the work. A newspaper has recently published an item which purports to give minute details. The statements therein are so misleading in character as to give rise to the impression that they were fabricated solely for the purpose of creating a sensation or of encouraging uninformed persons to engage in an illegal enterprise.

The truth of the matter is that pelagic sealing in the North Pacific Ocean, north of the thirtieth parallel of north latitude and including the seas of Bering, Kamchatka, Okhotsk, and Japan, is prohibited by an international agreement entered into in 1911 by the United States, Great Britain, Japan and Russia. The agreement is in perpetuity unless one or more of the parties thereto dissent. With the well-demonstrated benefits which accrue to all the governments concerned from the rational management of the fur-seal herds, there is little likelihood that any one will permit its citizens or subjects to resume at any time in the future the disastrous practise of pelagic sealing.

The United States and Canada cooperate fully in patrolling and protecting the Alaska fur-seal herd. U. S. Coast Guard vessels are ever on the alert to detect violations of the international agreement, and it is safe to say that any clandestine operations would come to grief in short order.

In the fiscal year 1920 the revenue to the United States government from the sale of fur-seal skins was $1,457,790. Aside from the revenue to this government, the governments of Great Britain and of Japan share in the annual take of Alaska fur-seals to the extent of 15 per cent. each.

THE PROPOSED CALIFORNIA ANTI-VIVISECTION LEGISLATION

THE board of regents of the University of California and the trustees of Stanford University have united in a protest against the anti-vivisectionist initiative. They say:

The advance of sanitation, modern medicine and physiology and the teaching of biology all rest on animal experimentation. The control of epidemic diseases, the management of surgical operations and of childbirth, and the certification of milk and water supplies would be impossible without the knowledge gained by such studies. In fact, the whole structure of the present-day protection of the public from disease rests upon animal experimentation.

The University of California and Stanford University are vitally interested in this initiative measure since its passage would stop the research work now going on in their medical schools, hospitals and laboratories, and in the Bureau of Animal Industry. The studies on botulism in olives, which will not only save the ripe olive industry of the state, but many lives, would cease, as would likewise the manufacture of serum for the prevention of hog cholera, the preparation of vaccine for anthrax, and the various other measures that annually save millions of dollars and prevent great suffering among domestic animals. Even feeding on animals would be impossible.

No worse attack on the welfare of the state and on the right of the university to seek and teach the truth could be made. Every man, woman and child, every unborn babe, every domestic animal in the state will be affected if this measure becomes a law. It is unnecessary special legislation due to prejudice and misinformation. No one will tolerate cruelty to animals. The present laws of the state are drastic and quite sufficient to control any abuse. We know that there is no cruelty to animals in the laboratories of the universities. They are in charge of men and women of the highest character, who are unselfishly working to better the lot of their fellow men. Anesthetics are always used for animals in the laboratory in exactly the same way that they are used by surgeons in the operating room. The real object of the antivivisectionist is not the prevention of cruelty to animals, but the prevention of progress in science and medicine.

THE SIXTEENTH ANNUAL NEW ENGLAND INTERCOLLEGIATE GEOLOGICAL EXCURSION

THE sixteenth annual New England Intercollegiate Geological Excursion will be held in the vicinity of Middletown, Connecticut, October 8 and 9, 1920. There will be two parts to the excursion. Friday afternoon the Strickland pegmatite quarry, Collins Hill, Portland,

will be visited. The quarry has produced in recent years a greater variety of interesting minerals than any other in this locality, and is always an attraction to visiting mineralogists.

Saturday the party will devote its attention to the faulting within the Triassic valley. The fault-line between the Lamentation Mountain block and the Hanging Hills block will be the particular study. Step faults and drag dips are frequent along the fault-line and give clear evidence of the magnitude of the faulting movements.

On Friday evening Professor W. M. Davis will speak on the Connecticut Triassic area as a whole. Professor W. N. Rice will then outline the details of the Saturday excursion and Professor W. G. Foye discuss the pegmatite quarries in the vicinity of Middletown. Immediately before these talks a luncheon will be served to the visiting geologists by Wesleyan University.

A collection of minerals from the pegmatites including one of the largest known collections of uraninites in the country will be on exhibition.

A cordial invitation is extended to all teachers and graduate students of geography and geology in the high schools, normal schools and colleges of New England.

LECTURES ON ASTRONOMICAL SUBJECTS AT THE CALIFORNIA ACADEMY OF SCIENCES

The first course of lectures to be offered this year by the California Academy of Sciences has been arranged and will consist of four or more lectures on astronomical subjects. Each lecture will be illustrated. The course will be as follows:

September 26. Dr. W. W. Campbell, director, Lick Observatory, Mount Hamilton, Calif. Subject: "The solar system."

October 3. Dr. A. O. Leuschner, dean of the graduate division, University of California. Subject: "Comets."

October 10. Dr. R. G. Aitken, astronomer, Lick Observatory, Mount Hamilton, Calif. Subject: "The binary stars."

October 17. Dr. J. H. Moore, astronomer, Lick Observatory, Mount Hamilton, Calif. Subject: "The nebulæ."

SCIENTIFIC NOTES AND NEWS

Dr. Leo S. Rowe, assistant secretary of the treasury and formerly professor of political science in the University of Pennsylvania, has assumed the directorship of the Pan-American Union at Washington, succeeding Dr. John Barrett, who has retired after fifteen years as head of the union.

At a meeting of the Society of Chemical Industry in New York City on September 27, the Grasselli medal was conferred on Dr. Allen Rogers, of the Pratt Institute. The presentation address was made by Professor M. T. Bogert.

Professor Frederick Haynes Newell, head of the department of civil engineering at the University of Illinois and formerly director of the United States Reclamation Service, has resigned and will go to California.

Dr. Ernest W. Brown, professor of mathematics in Yale University, is on leave of absence during the first half of the current academic year and is sailing for England early in October to be away for a couple of months. His address there will be Christ's College, Cambridge.

Professor Charles A. Kofoid, of the University of California, has returned to Berkeley from a tour of the British and French institutes of parasitology and tropical medicine. He delivered addresses at the British Association for the Advancement of Science on "Hookworm and human efficiency" and on "The neuromotor system of flagellates and ciliates and its relation to mitosis and the origin of bilateral symmetry." He was elected vice-president of the Zoological Section of the association and received the honorary degree of doctor of science from the University of Wales.

Mr. E. C. Leonard, of the division of plants, U. S. National Museum, who accompanied Dr. W. L. Abbott to Haiti in February for botan-

ical explorations, returned to Washington on July 30.

PROFESSOR JOSEPH F. ROCK, formerly professor in the College of Hawaii, Honolulu, has left Washington upon an extended trip of agricultural exploration in eastern Asia for the Office of Foreign Seed and Plant Introduction, U. S. Department of Agriculture, with which he has recently become connected.

AT the congress of physiologists held in Paris last July under the presidency of Professor Charles Richet, the Americans in attendance were Professor G. N. Stewart, Western Reserve University; Professor Frederic S. Lee, Columbia University; Professor Graham Lusk, Cornell University; Dr. L. J. Henderson, Harvard University; Professor J. J. R. Macleod, Toronto University, and Professor Fraser Harris, Dalhousie University.

SIR WILLIAM MACEWAN has been elected president of the International Society of Surgery, whose next meeting will probably be held in London during the summer of 1923.

THE following officers of the Pacific Division of the Phytopathological Society of America have been elected and will hold office for two years: *President,* Dr. H. S. Reed, Riverside, California; *Vice-president,* Dr. J. W. Hotson, University of Washington, Seattle; *Secretary-Treasurer,* Dr. S. M. Zeller, Oregon Agricultural College, Corvallis, Oregon.

J. J. DAVIS has resigned as agent in charge of the Japanese beetle control project at Riverton, New Jersey, to accept a position as head of the departments of entomology of Purdue University and the Indiana Agricultural Experiment Station, effective on October 1.

MR. R. M. OVERBECK, geologist, has resigned from the U. S. Geological Survey to accept a position with an oil company.

THE *Proceedings* of the Washington Academy of Sciences states that while in charge of a Coast and Geodetic Survey subparty working in New Mexico, Mr. R. L. Schoppe was struck by lightning and seriously burned, but is recovering.

ACCORDING to the Berlin correspondent of the London *Times* Professor Einstein is so much disgusted by attacks made upon him by certain of his anti-semitic scientific colleagues that he may leave Berlin altogether. The *Tageblatt* makes a strong protest against the annoyance to which Professor Einstein has been subjected, which it describes as disgraceful. It says: "It is the duty of the Berlin University to do all in its power to keep Professor Einstein. Every one who desires to maintain the honor of German science in the future must now stand by this man." Professor Einstein himself makes a reply in the *Tageblatt* to his assailants. He ends by saying that it will make a singularly bad impression on his confrères to see how the theory of relativity and its originator are being traduced in Germany.

THE botanists of America have sympathized deeply with the eminent French bryologist, M. Jules Cardot, whose house at Charleville was wrecked and the most valuable part of his library and collections destroyed by the German invaders. Not only was this done, but M. Cardot's fortune was so impaired by the loss of property due to the war that, for the present at least, he has given up his studies and entered the service of the French Government of Indo-China. A portion of M. Cardot's library and collections valued at 10,000 francs has been acquired by the French National Museum at Paris. The museum contributed 5,000 francs, English bryologists and botanists 2,500 francs and members of the Sullivant Moss Society in excess of the other 2,500 francs. The success of the American subscription was due largely to the efforts of the secretary of the society, Mr. Edward B. Chamberlain.

ARMAND GAUTIER, long professor of biological and medical chemistry in the Paris School of Medicine and distinguished for his contributions to these subjects, has died at the age of eighty-two years.

DR. D. P. VON HANSEMANN, professor of pathologic anatomy at Berlin, has died at the age of sixty-two years.

W. P. Ruysch, inspector-general of the public health service of the Netherlands and since 1912 president of the public health advisory council, has died at the age of seventy-two years.

Professor Celoria, director of the Milan Observatory died on August 17, at the age of seventy-eight years.

The *Observatory* announces the death of Professor A. Berberich, of the Astronomische Rechen-Institut of Berlin, sometime editor of the *Astronomischen Jahresbericht* and of Robert Philippovitsch Simon Vogel, professor of astronomy and geodesy in the Vladimir University in Kieff, and since 1901 director of the Kieff Observatory.

The U. S. Civil Service Commission announces an examination for computer, Bureau of Mines, on November 3, 1920, to fill a vacancy in the Bureau of Mines, Pittsburgh, Pa., at $1,500 a year.

The eighth annual Indian Science Congress will be held in Calcutta from January 31 to February 5, 1921, under the presidency of Sir R. N. Mukerjee.

The Carnegie Institution of Washington published on September 9, 1920, the second volume of the Cactaceæ by N. L. Britton and J. N. Rose. The first volume of this work was issued June 21, 1919.

Many American nations, as well as Great Britain, Spain and Portugal, are to be formally invited to participate in the national festivities in November and December in commemoration of the four hundredth anniversary of the discovery of the Straits of Magellan. The festivities will center principally in Santiago and Punta Arenas, the latter the world's southernmost city, where the occasion will be marked by inauguration of important public works, including port improvements, lighthouses in Smith Channel, a highway between Punta Arenas and Natales on the South Atlantic coast and laying of a cornerstone of the Punta Arenas University. It is expected the foreign delegations will visit the straits in December, when warships of the Chilean navy will be assembled there. It was through these waters that Ferdinand Magellan, the Portuguese explorer, first passed in November, 1520.

UNIVERSITY AND EDUCATIONAL NEWS

Under the will of the late Mrs. William J. Wright Harvard University has been left over $23,000, to be known as the "William J. and Georgiana B. Wright Fund," the income to be used for medical research and the advancement of the medical and surgical sciences. A bequest of $14,000 has been made by the late Dr. James Ewing Mears, of Philadelphia, for the maintenance of a scholarship in medicine and for the work of the Cancer Commission. Edwin F. Atkins, of Boston, has given $12,000 for tropical research in economic botany.

Dr. Robert Waitman Clothier, professor of farm economics in the Mississippi College of Agriculture and Mechanic Arts, has become president of the New Mexico College.

At Yale University Adolph Knopf, Ph.D. (California), from the U. S. Geological Survey, becomes associate professor of physical geology and petrology, and Robert A. Patterson, Ph.D. (Yale), assistant professor of physics.

Professor Oscar H. Plant goes to the University of Iowa this year as professor and head of the department of materia medica and pharmacology. Dr. C. S. Chase, who has been head of the department for many years and a member of the faculty since 1892, remains with the university as full professor in the department and will teach pharmacology and engage in research and writing.

Dr. Otto Stuhlman, Jr., formerly at West Virginia University, has been appointed associate professor in physics at the University of North Carolina, which has enlarged its physics staff since the completion of Phillips Hall, the new laboratory.

It is reported in Nature that Dr. R. M. Caven has been appointed to the chair of inorganic and analytical chemistry in the Royal Technical College, Glasgow, This vacancy was caused by the transfer of Dr.

F. J. Wilson to the chair of organic chemistry in succession to Dr. I. M. Heilbron, who was recently appointed professor of organic chemistry in the University of Liverpool. Dr. Caven was for many years lecturer in chemistry at University College, Nottingham, a position he resigned to become Principal of the Darlington Technical College.

Dr. Harold St. John, formerly assistant at the Gray Herbarium of Harvard University, has accepted an assistant professorship of botany at the Washington State College.

At the British Empire Forestry Conference in London Lord Lovat dealt with the question of education. According to the London *Times* he said that higher forestry education subsidized by the state had been carried on until recently at eight or nine educational centers. The Forestry Commission had arrived at the conclusion that the forest authority subsidies should only be granted to those centers of education and research which were directly required to carry out the state's forest policy. Educational centers are required for higher forestry education for the training of men who wished to take up forestry as a career, *i. e.*, the forest-officer class; for education in the theory and practise of woodland management for owners and managers of private woodlands; and for education in practical forestry for working foresters and foremen who intended to go in for state or private forest service. The Forestry Commission have therefore come to the conclusion that as far as state assistance went their interest should be confined to the following objects: (1) To assist in the establishment of the machinery (staff equipment and facilities) for a complete course of higher forestry education at one of the universities in the British Isles. (2) To subsidize certain specialized courses, of which forestry engineering should certainly be one, which could be taken as a post-graduate or fourth-year course at one of the other universities. (3) To be responsible for the payment of a lecturer in forestry at certain universities and colleges where adequate agriculture and estate management courses are established, and to set aside sufficient state woodland for practical instruction. (4) Subject to certain payments by private owners, to be responsible for the establishment and upkeep of not less than seven or more than ten working foresters' schools.

A memorial has been presented to the German National Assembly urging the formation of an Imperial Chemicotechnical Laboratory, which it is recommended should be formed from the Military Test Bureau which existed during the war. *Nature*, quoting from the *Zeits. des Vereines deutscher Ingenieure* says that it is suggested that the functions of the new laboratory should be, *inter alia*, the execution of scientific and technical investigations relative to raw materials, and particularly (1) the production of materials of importance to the public, *e. g.*, spirit from wood and acetylene instead of from potatoes, and of fatty acids from the products of coal- or lignite-tar or paraffin, and the utilization and improvement not only of cellulose as a substitute for cotton, but also of ammonium nitrate obtained synthetically in large quantities as a fertilizer; and (2) the determination of substitutes for chemical and metallurgical products not available in the country or of which there is a shortage, *i. e.*, substitutes for paraffin, camphor, and glycerine, for substances used in the preservation of leather and metals, also substitutes for lubricants, rubber, gutta-percha, etc. In addition, the proposed new institute would carry out researches of general interest, *e. g.*, on rust-prevention and the corrosion of metals, on the determination of stresses in internal- combustion engines, on the effect of winter cold and the upper-air temperatures on implements and raw materials, and on the testing and improvement of aeroplane and airship fabrics. It is also suggested that scientific and technical investigations should be carried out dealing with the prevention of accidents and the protection of workers in a number of important industries.

We learn from Nature that Mr. John Quiller Rowett has contributed £10,000 towards the endowment of an Institute for Research

in Animal Nutrition in connection with the University of Aberdeen and the North of Scotland College of Agriculture. The new institute, which will be named the Rowett Research Institute, has secured the services of Dr. J. B. Orr, the director, recently associated with Professor E. P. Cathcart in the conduct of a study of the energy output of soldiers, and Dr. R. H. A. Plimmer, chief biochemist in the institute, a research worker in the Physiological Institute of University College, London.

Professor George C. Comstock, director of the Washburn Observatory of the University of Wisconsin, forwards the following extract from a letter to be published as a warning to prospective victims: "A short time ago, a man representing himself to be a nephew of yours and giving his name as Mr. R. L. Denny, of 64 Riverside Drive, New York City, obtained a loan of $8.00 from me after putting up a good story of having lost his pocket-book, being a stranger in the city, etc. I have not heard of him since. I have reason to believe that he is a clever 'crook' working among college men."

The British Ministry of Agriculture is arranging a series of investigations and exhaustive experiments with regard to certain aspects of foot-and-mouth disease, and for this purpose the Admiralty is placing obsolete warships at the disposal of the Ministry for use as floating laboratories. The ships will be fitted with every essential for the study of the disease, and it is understood that there is no intention of disclosing off which coast the ships will be stationed. An official of the ministry informed a representative of *The Times* that the experiments are to be carried out at sea to obviate any risk of the disease spreading from the experimental station. The investigators will include members of the staff of the ministry and other scientists, including several distinguished foreigners. In dealing with a disease of which the virus is presumed to be ultra-microscopical, and of which the contagion may be air-borne, the difficulties must be very considerable, and the research may last for years. A previous attempt was made to solve the problem by sending a commission of investigation to India, where it was found that cattle were immune. The necessity of stamping out the disease, it was pointed out, is imperative, if England is to maintain her large cattle exports. Foreign buyers will not take the risk of purchasing cattle in England for transport to the Continent while the danger of foot-and-mouth disease exists. So contagious is it that a healthy animal, passing along a road that had been traversed twelve hours previously by an infected animal, may contract the disease.

DISCUSSION AND CORRESPONDENCE

THE BOUNDARY BETWEEN THE SILURIAN AND DEVONIAN IN SHROPSHIRE AND FRANCE

During the German occupation of Lille, Professor Charles Barrois and his able assistant, Dr. Pierre Pruvost, being confined to the city, busied themselves as much as was allowed studying the many undetermined fossils that had been accumulated during the past twenty years by various coal companies of the Calais basin. Not only this, but they also studied in greater detail the local stratigraphy, with the result that we now have a preliminary statement from them entitled "Sur les couches de passage du Silurien au Dévonien dans le bassin houiller du Pas-de-Calais."[1] The complete work is to follow later.

The chief conclusion reached is that the line between the Silurian and Devonian should be drawn at the base of the lower Gedinnian, which in the Ardois is the Bois-Bernard arkose immediately beneath the tentaculite shales of Méricourt; in the Ardennes and Brabant this is the conglomerate of Fépin, which lies at the base of the Mondrépuits shale. To make this matter clearer, the authors also correlate the various horizons studied by them with those of Shropshire, with rather surprising results. All of the "passage beds" (Temeside shales at the top, followed beneath by the Downton Castle sandstone (= Tilestones), and the Ludlow bone-bed) are referred to the base of the Lower Devonian. The Silurian of the

[1] *Comptes rendus, Acad. des Sciences*, Vol. 167, 1918, pp. 705–710.

type area, therefore, ends with the *Chonetes* flags of the upper Ludlow.

These correlations have been accepted by L. D. Stamp for Shropshire and South Wales.[2] In southern Wales the *Grammysia* beds are regarded as transitional between the upper Ludlow and the lower Gedinnian, here the Trichrûg beds.

The evidence for drawing this boundary between the Silurian and Devonian systems is primarily based on diastrophism, though fossils have always been given full consideration, lithology being regarded as of least value.

It now appears clear that the black limestones of Bohemia known as the Ff_1 beds, and the Tentaculite limestone or the Manlius of New York must also go into the Lower Devonian. Just where the division line in Maryland, Pennsylvania, and New Jersey will be drawn is, however, not so clear, for here there appears to be a more or less complete transition from the Silurian (Tonoloway) into the Manlius equivalent. The last worker on this problem, J. B. Reeside,[3] was not able to adjust the matter.

CHARLES SCHUCHERT

[2] *Geol. Mag.*, April, 1920, pp. 164–171.

[3] Prof. Paper 108-K, U. S. Geol. Survey, 1917.

THE MEASUREMENT OF POSTGLACIAL TIME

TO THE EDITOR OF SCIENCE: The proposal of DeGeer to measure postglacial time in North America by the lamination of glacial clays and its criticism by Fairchild are of special interest to phytogeographers who see in early postglacial migrations of plants the fundamental explanation of the present conditions of plant distribution. Fairchild has taken exception to some of DeGeer's statements, especially his estimate of 20,000 years for postglacial time, and has apparently adopted Taylor's computation of 75,000 to 150,000 years for the recession of the ice from Cincinnati to Mackinac. In this connection it is of interest to refer to a paper of DeGeer's published in 1908. In it he stated that the recession of ice in southern Sweden was as slow as 25 meters per year, rose to 130 meters, stopped for 100 to 200 years, began again at 20 meters, and gradually accelerated to 400 meters per year. If one assumes DeGeer's minimum figure of 20 meters as an average annual rate in Michigan and Ohio, 36,000 years would be sufficient to cause an ice recession from Cincinnati to Mackinac. Since this region is farther south and with less rainfall than Sweden, it is fair to presume that the rate was much more rapid. Assuming DeGeer's average figure of 200 meters per year, 3,600 years would have produced the same result. Neither is it necessary to invoke the precession of the equinoxes to explain the fifteen frontal moraines on the way. DeGeer states that frontal moraines were formed in Sweden during a stationary period of 100 to 200 years. Such periods may have resulted from cylic variations in temperature, as DeGeer believes, or from similar variation in precipitation. The latter are of course well authenticated through the researches of Huntington and others. Allowing 400 years for such stationary periods, the total time of ice retreat over this distance is still within 10,000 years.

H. A. GLEASON

NEW YORK BOTANICAL GARDEN

EXPLORATIONS IN THE PANHANDLE OF TEXAS

THE third expedition to northwestern Texas and Oklahoma completed its labors about the first of July. This expedition found more than two hundred small stone buildings in groups scattered through a territory approximately 200 × 100 miles in extent. It appears that these are not distinct Pueblo type of architecture but rather mark the gradual evolution of a nomadic buffalo-hunting tribe of Indians to people who lived in stone dwellings. Near the Oklahoma line the buildings are small and rudimentary, and as one proceeds westward they increase in size and numbers. The art also develops. A preliminary paper has been published setting forth the observations on the artifacts, irrigation ditches, pictographs and buildings. These will be mailed free of expense to any interested persons by the author.

W. K. MOOREHEAD

ANDOVER, MASS.

QUOTATIONS

THE BRITISH ASSOCIATION AT CARDIFF

THE Cardiff meeting of the British Association for the Advancement of Science came to a successful end last night. Any attempt to follow, or, still more, to report, its proceedings in detail was baffled by the multitude of subjects covered, and the subdivisions of the association into specialized sections. There were eleven sections and one subsection at work simultaneously every day, to say nothing of a number of committees, subcommittees, and conferences. Some of the papers and discussions dealt with questions of the widest interest; there were others apparently admitted only to gratify individual readers or speakers, or to pander to notoriety. There was a notable tendency to combination of the sections for the discussion of borderland questions, and on every occasion where this took place the attendance at the combined meetings was much larger than the sum of the attendances at separate meetings. It is understood that such concentration has the sympathy of the council and officers. We trust that it will be encouraged, and we could wish that it would lead to a permanent fusion, at least for the purpose of the public meetings, of kindred sections. The general standard of the proceedings was highest in Section A, which has most successfully resisted subdivision, although it covers mathematics, astronomy, and the physical sciences.

The leading scientific feature of the meeting was the president's exposition of the need and advantage of increased study of the sea. The Lord Mayor expressed the hope that some of the merchant princes of Cardiff might be led to establish a department of oceanography attached to the university or to the National Museum of Wales. Far be it from us to offer advice that might chill local generosity. Hitherto private munificence has played a greater part in the encouragement of learning and research in America than in England and Wales. But oceanography requires expensive equipment. The chair established by Professor Herdman himself at Liverpool and the station of the Marine Biological Association at Plymouth still need encouragement and support. Much better work might be accomplished by two good than by three indifferent centers. Although research must have a local habitation, its results are of universal benefit. If the hearts of the magnates of Cardiff warm to the science of the sea, their benevolence, although bestowed on Plymouth and Liverpool, would still assist the fisheries and the ocean traffic of their own city. But if local munificence must have an object characteristically local, there are many opportunities for research strictly bearing on other industries of South Wales.

The President made the interesting suggestion that the time had come to prepare a new "Challenger" expedition. He was supported by all the sections concerned, by physicists, astronomers, zoologists, botanists, geographers, and geologists, all of whom know of scientific and practical problems requiring investigation at sea. Mr. F. E. Smith, Director of the Admiralty Board of Research, at the conference held on Thursday afternoon, stated that the Lords of the Admiralty favored the idea, with the reservation that the whole cost of an expedition, which would have objects far beyond naval requirements, should not fall on the Navy Estimates. The original "Challenger" expedition was financed by the government, on the invitation of the Royal Society. From 1872 to 1876 the ship sailed all the oceans of the world, except the Indian Ocean, which the government of India wished to be reserved. The results were issued in fifty volumes issued from 1880 to 1895, under the guidance of the late Sir John Murray. By general admission the "Challenger" expedition was the greatest scientific exploit in aim and achievement undertaken before or since. But, like all scientific research, it showed the need of further research, for the deepest dredge can not bring up all the secrets of nature. The general committee of the British Association recommended their council to appoint a small expert committee to devise a program of work, and to consider the technical apparatus and the scientific staff

that would be requisite. Adequate preparation of a scheme may take several years, perhaps in the circumstances a fortunate delay. For a new "Challenger" expedition will be very costly, and we trust that the government and the national finances will then be in a better position to undertake what certainly should be a national enterprise.—The London *Times*.

SCIENTIFIC BOOKS

Principles of Animal Biology. By A. Franklin Shull, with the collaboration of George R. La Rue and Alexander G. Ruthven. McGraw-Hill Book Co., Inc., New York.

Most teachers of elementary zoology have for some time acknowledged that the almost exclusively morphological texts fail to give the beginner in the science a fair introduction to the field of zoology. Several recent texts and revisions of some of the older ones have endeavored to meet the demand for a more thorough treatment of the underlying principles of the subject. For one reason or another most of these attempts have failed to meet with general approval. In many instances they have remained predominantly morphological with intercalated sections on the principles. The Principles of Animal Biology by Shull, La Rue and Ruthven promises to meet the requirement for a text dealing with the fundamental biological principles far better than any other that has appeared to date.

Throughout the text there are brought together distinctly modern view points regarding the various subsciences of zoology. The book is not only well written so that the reader is fascinated by the smoothness of the narration but in addition it has all appearances of being so organized that it may be easily assimilable by the beginning student. In only a few instances does the treatment seem to be beyond the grasp of the average student. In the discussion of the physiology of cells (Chapter III.) the extent of chemical knowledge assumed to be possessed by the student is rather great. The structural formulas and the highly technical chemical terminology would not be intelligible to the average freshman, but this is not any fundamental criticism of the book for most teachers are coming to realize that a certain amount of consideration must be given the unusual student.

The book is distinctly the result of a reactionary movement away from the more stolidly morphological and taxonomic treatment of the subject of zoology. A point might be raised as to whether it is not possible that the taxonomic aspect has been curtailed to the extent of impoverishing the opportunity of citing comprehensible instances of the principles for the average student. Correlation of laboratory work and text assignments might easily obviate this possible difficulty. Content of an elementary course and the relative emphasis to be placed upon the various phases of the science are by no means matters of universal agreement among zoology teachers. Consequently a criticism like the foregoing may in the end prove to be either a valid judgment of the text of an ultimate criticism of the one offering it.

H. J. Van Cleave

University of Illinois

SPECIAL ARTICLES

PRELIMINARY INVESTIGATION OF RIBES AS A CONTROLLING FACTOR IN THE SPREAD OF WHITE PINE BLISTER RUST[1]

Most authorities will now admit that the complete eradication of the white pine blister rust from the country is not possible, but they consider it both possible and feasible to control the disease to a certain extent and to protect certain definite areas of pine. It is also agreed that such protection must be exercised through the eradication of *ribes*.

Under these conditions, the control of the white pine blister rust, or rather the protection of the white pine, depends on a definite knowledge of the habits of *ribes*, especially of the wild plants, and their reactions to different treatments. Projects were there-

[1] Published with the approval of the Director as Paper No. 209, of the Journal Series of the Minnesota Agricultural Experiment Station.

fore planned and working plans drawn up to cover the following points.

For the purpose of these projects the land was classified into swamp, moist and dry.

PROJECT I

To study the sprouting of different species of ribes eradicated in different months and under different moisture conditions.

In the land which was cleared in May twenty-five bushes were located in dry ground and twenty-five in moist. No swamp was worked. These bushes were marked with numbered stakes and exactly located on a map.

The following data was noted for each bush: (*a*) whether plant was pulled or grubbed; (*b*) whether part of crown was left or only side roots; (*c*) whether sprouts came from the crown, the cut ends of side roots, or as suckers from the roots; (*d*) number of sprouts, date of sprouting and species.

This same schedule was duplicated on areas cleared in June, July, August and September.

Bushes were selected which were eradicated about the middle of the month, so that the intervals were about even.

PROJECT II

To study the cost and effectiveness of eradication of *ribes* in different months.

Five quarter-acre plots were laid out in dry land—either brush or forest land—not meadow or tilled land—in the area eradicated in May. The same was done on the moist land type.

This schedule also was repeated in June, July, August and September.

These plots were permanently marked with stakes, as they will probably be studied for the next three or four years at least.

After the eradication crew had gone over this area, the plots were carefully examined to see what was left. The plants found were classified by species as sprouts, seedlings under six inches, and old plants.

PROJECT III

To determine the number of years eradication will have to be practised.

The plots established for Project II. will be studied for a series of years, and the development of the *ribes* noted.

PROJECT IV

To study the reproduction of different species of *ribes* by seed and layering.

A number of plants of each species were located in both moist and dry types in pine woods, in hardwoods, in brush land, in sod land and in swamps.

Seed was collected from each species at weekly intervals and in all stages of maturity. Some of it was tested at once for germination, some was stratified and held for germination tests in the spring.

Plots of seedlings were staked out and counted from time to time and survival noted. They will be checked again in the spring to see how many were winter killed.

PROJECT V

To determine the effect of pruning and cutting off the roots at different depths and different dates.

A number of bushes of each species were located both in the dry land and moist types.

Some of these were cut off above the crown, some just below the crown and some six inches below the surface.

This was done in June and duplicated in August.

PROJECT VI

To determine growth habits of each species.

A number of plants were located and put under surveillance. Their future development will be studied.

The infected area around Rush Lake, Minnesota, was selected for the experiments. Eradication of *ribes* had been carried on there in the summer of 1918 and was in progress during the summer of 1919. It is a rolling country of hills, and swamps. All stages of cultivation are represented from wild woodland, through brushland and pasture, to cultivated fields. Most of the woodlands are made up of mixed hardwoods—butternut, red oak, white birch, bitternut, hickory, basswood, sugar maple and white ash, with a large mixture of black ash in the lowlands. Here and there is a small patch of pure white pine and

in many places there are a few white pine scattered through the hardwoods and pastures.

The ground cover is grass, goldenrod, blueberries, blackberries, raspberries and the common roadside weeds. The brush on the highland is prickly ash and hardwood reproduction with zones of dense alder and raspberries around the edges of the swamps. The soil is mostly sandy loam, rather light.

Five species or *ribes* are common there. *R. cynosbati* predominates on the dry lands. *R. oxyacanthoides, R. floridum, R. triste* and *R. prostratum* occur in the swamps in the order named.

The results of the first season's work under this program are interesting and significant, but not conclusive. The data in many instances was found to be too meager and at least one more season's work will be necessary before any very positive statements can be made, but there are some very strong indications.

There was a decidedly higher percentage of sprouts from the plants eradicated on the moist type than on either the dry or the swamp type. In fact no sprouts at all were found on either *R. triste* or *R. prostratum* in the swamps. This would seem to indicate that more sprouting might be expected from plants on the dry land type in a very wet summer than in a dry one.

There was a larger percentage of sprouts from the plants which were grubbed than from the plants which were pulled. It was significant that a majority of the sprouts on pulled plants came from the root ends, while a majority of those from the plants grubbed out came from pieces of the crown which were left. Only two root sprouts from grubbed plants were found. In no case, either from pulled or grubbed plants, were there any root sprouts, *except where the root ends were exposed to the light.*

The tendency to sprout from the root ends seemed much stronger in plants pulled in May and June than late in the summer. Possibly this was due to the greater moisture in the ground in the spring months. This did not apply to crown sprouts which seemed to develop equally well in any month of the summer.

Where plants were cut off above the crown they almost invariably sprouted in all types and at all seasons with the exception of the swamp species, triste, which showed very little tendency to sprout at all. Plants cut off below the crown showed very little tendency to sprout. In fact the only sprout found was on a root end which was dragged to the surface in the process and left exposed to the light.

A study of the plots laid out in the eradicated area seems to indicate that there is very little difference in the efficiency of radication in the dry, moist, or shallow swamp types, while the number of plants left in the deep swamp is hopelessly large. The eradication done in May and June seemed much less effective than that of July and August, but this may have been due to the fact that the crews were inexperienced at the start.

The number of large plants missed by the eradication crews was very small, representing on the average far less than five per cent. of the original stand.

The number of seedlings missed is naturally very much larger, but their leaf surface is very small, none of them were found to be infected and it is questionable whether they live over to the second season in very large numbers. Plots of seedlings counted in July and August and checked late in September showed a decrease of 25 per cent. while very few two-year-old seedlings were noted anywhere.

Up to December 1 no germination had been obtained from any of the seed collected the summer before.

CONCLUSIONS

Incomplete as this study is it seems to indicate an important change in the method of eradication. The number of large plants missed is very small, the number of seedlings, though large, is not excessively large, and the sprouts make up a very large per cent. of the leaf surface on eradicated land. If it is true, as this study indicates, that practically all of

the sprouts come from pieces of crown and from root ends which are exposed to the light, the sprout can be eliminated by careful practise in eradication. Cutting of the roots would seem to be more effective than pulling: ordinary care will prevent the leaving of pieces of crown in grubbing, while only extraordinary care and considerable work can prevent the leaving of exposed root ends after pulling. In the past it has been the custom in this state to pull whenever possible and to grub only as a last resort. It looks as though the practise should be reversed. The initial work may be a little more expensive, but it will be cheaper in the end if it eliminates the sprouts which make up the great bulk of the growth on eradicated areas.

According to the figures obtained the eradication crews attained an average efficiency of almost 99 per cent. on old bushes and seedlings. If the sprouts can be eliminated the reduced leaf surface should certainly give a large measure of protection if not complete exemption from the disease.

E. G. Cheyney
University of Minnesota

THE AMERICAN CHEMICAL SOCIETY. XI

Division of Agricultural and Food Chemistry

C. E. Coates, *chairman*

T. J. Bryan, *secretary*

Louisiana molasses and syrup: C. E. Coates.

The use of refined edible lactic acid in food products: George Defren.

Preliminary feeding experiments with pigs to determine the nutritive value of the amino acids of the proteins of feeding stuffs: H. S. Grindley.

Proteins of pecans: C. T. Dowell.

Body fat of hogs fed on peanuts: Fred H. Smith.

An accurate and rapid dry combustion method for the simultaneous determination of soil organic matter and organic carbon: J. W. Reed.

The actual carbon content of soil organic matter and its relation to the use of conventional factor: J. W. Reed and R. H. Ridgell.

Limitations of the white rat as an experimental animal: W. D. Richardson.

Mammalian vs. Avian dietary experiments: W. D. Richardson.

The ether insoluble hexabromides of pure and adulterated linseed oils: Herbert Bailey and W. D. Baldsiefen. Several modifications of the various methods which have been proposed from time to time for the determination of the hexabromide value of oils have been studied. As a result of this work a new method has been developed which, it is believed, is as accurate as any of those previously proposed, and more simple than most of them. The hexabromide values of a number of samples of pure linseed, soya bean, and other oils, and mixtures of linseed with soya bean oils have been determined.

The relative nutritive value of alfalfa as a supplement to a diet of corn and tankage, and kaffir and tankage: J. S. Hughes and E. F. Ferrin.

Data on bacterial counts of beverages in Missouri: Jay Barton. Excluding 23 samples from 3 different plants which were in an appalling condition, the average count for the remaining 203 samples is 71 per cubic centimeter. The three worst plants were in towns of population 5,000 or less. The average count of all samples from each of three other plants was between 100 per cubic centimeter and 150 per cubic centimeter; these plants were located in cities of 40,000 or more. *B. coli* were found in 8 samples collected from 5 plants. Only one of these plants was in a small town; the other four were in cities of 75,000 or more. *B. coli* were found in all of the products from one company manufacturing imitation wine. "Fancy" ginger ale (4 samples), grape juice (8 samples) and dealcoholized beer (80 samples) run uniformly good, about half of the samples containing no organisms growing at 37° C., and not more than 5 per cent. containing more than 10 per cubic centimeter.

The occurrence of hydrocyanic acid in Sudan grass and its effect on cattle: C. O. Swanson. Samples of Sudan grass taken from a pasture where cows were feeding showed that large amounts of hydrocyanic acid was present, but no ill effects were observed. Sudan grass which was reported to have killed cattle did not apparently contain more of the HCN than the grass from the pasture mentioned. Conditions which favor enzyme action liberate hydrocyanic acid. Frosted Sudan grass gave a stronger test than that not frozen, but the HCN disappears very rapidly when the plant thaws out and dries. Ensiloing favors the liberation of

the HCN. The tests must be made on the grass immediately after cutting, as the HCn was generally absent after the grass was wilted.

Effects of alfalfa on the sulphur content of the soil in comparison with grain crops: C. O. SWANSON and W. L. LATSHAW. Samples were taken from 86 fields and analyzed for sulphur. The plan was to select fields which had been in alfalfa for a long time, twenty to thirty years. Near these fields were found soils of the same type which were in native sod or had been cropped to grain since broken, about forty years. On the basis of annual rainfall the state of Kansas may be divided into three sections: humid, where the rainfall is 30 inches or more; the subhumid, where the rainfall is less than 30 inches but more than 22; the semi-arid, where the rainfall is less than 22 inches. In the humid section the average per cent. of sulphur was: alfalfa soil, 0.029; virgin sod, 0.035; cropped soil, 0.027. In the sub-humid section: alfalfa soil, 0.043; virgin sod, 0.045; cropped soil, 0.041. In the semi-arid section: alfalfa soil, 0.035; virgin sod, 0.038; cropped soil, 0.027. The growing of crops has decreased the sulphur content of the soil, using the virgin sod as the basis of comparison: Alfalfa, 16.5 per cent.; grain, 20 per cent. This is for the humid section. For the sub-humid section the losses are: alfalfa, 4.7 per cent.; grain, 9.3 per cent.; for the semi-arid section the losses are: alfalfa, 7.4 per cent.; grain, 30 per cent. The sulphur content of the soil is approximately the same as that of phosphorus. Chemical analyses of these soils do not show any appreciable loss of total phosphorus, while the loss of sulphur is next to nitrogen and carbon in magnitude.

The preservation of fish frozen in chilled brine: (I.) The penetration of salt: L. H. ALMY and E. FIELD. Several species of fish were frozen by immersion in sodium chloride solutions of different concentrations and temperatures and for varying periods of time. Salt penetrated the skin and superficial tissue under all experimental conditions. Freezing of fish in brine at the temperature near which ice begins to separate from the solution did not prevent the penetration of salt. Though it was possible to detect penetrated salt by chemical means, the amount of salt absorbed was not sufficient to influence the taste of the cooked product. A study is being made of the relative keeping of fish frozen in air and in brine.

Research on hypnotics: E. H. VOLWILER. The most commonly used hypnotics at the present time are barbital, formerly known as veronal, luminal, adalin, diallylbarbituric acid and several others. Of these compounds, barbital is by far the most commonly used and is manufactured in this country in very large amounts. Recently some research has been carried on by The Abbott Laboratories, which is the principal manufacturer of barbital, to produce a better hypnotic. Among others, di-butyl barbituric acid and benzyl-ethyl barbituric acid have been prepared. Di-butyl barbituric acid shows promise of being valuable, its toxicity being somewhat less than that of barbital and several objectionable side effects being eliminated.

Wood alcohol and prohibition: CHARLES BASKERVILLE. Wood methyl alcohol poisoning is a unique problem in that it involves not alone physiological changes and technical matters having to do with production and distribution of the toxic agent, but sociological factors as well, for it is closely knit to prohibition. The pure substance so closely resembles ethyl hydroxide that it requires an expert chemist to determine the difference. As ethyl hydroxide was the constituent of the quondam beverages, the name without the qualifying words is liable to be misleading to those not informed. In view of that, and numerous other factors, it is urged that the name "methyl hydroxide" or "methanol" be applied to wood alcohol, and the name "ethyl hydroxide" or "ethanol" be applied to the so-called grain alcohol in an effort to render the use of the word *alcohol* itself obsolete. This can not be accomplished by legislation or immediately, but by common agreement in usage, especially in the chemical and pharmaceutical professions.

CHARLES L. PARSONS,
Secretary

(*To be continued*)

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.
NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, OCTOBER 15, 1920

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE SCIENTIFIC TEACHING OF SCIENCE

SCIENCE, with its introduction of the laboratory, was expected to revolutionize teaching. But the ever-recurring distrust of the new has given us a curious combination in our scientific departments of the modern laboratory, the medieval lecture, and a degenerate form of the Socratic quiz. And the student feels them about as far apart in content as in origin. While the head of the department is lecturing to him on chlorine, the second man in the department is directing him in the manufacture of sulfur dioxide, and some assistant, once a week, is extracting from his brain all it contains of hydrogen sulfide. An unsavory mess it is!

If we could accept as the purpose of education the development—perhaps it is more accurate to say the restoration—of the right mental attitude in the student, we could bring order out of this chaos. For we should then see that the dogmatic handing on of facts through lecture and text-book inculcates the wrong attitude of mind in the student. A student will much more rapidly develop the right mental attitude by discovering facts for himself, even though they were known before, than by memorizing a multitude of facts discovered by other people. Men prate a good deal these days about the conservation and development of our natural resources, and are curiously neglectful of our greatest resource, humanity's power of creative thinking. The little child is, of course, the scientist, par excellence, curious, experimental, creative. Our education must retain and build on the curiosity and experimental eagerness of the child, and develop his power of creative thought. We can never know what the new generation has to contribute to us till we give it greater opportunity to express itself. We think when we have let a student choose his

major subject we have given him all the freedom it is safe to give him.

It is curious how far we are from the idea that a university exists primarily to develop this power of creative thought in its students. If our teaching is to develop this power, we much change the focus of our work. Heretofore we have had vaguely in mind as our focus a text-book or an instructor. But instead of a tyrannical text-book or the instructor's somewhat egotistical presentation of ideas in his lectures, instead even of his charming and stimulating personality, we must chose as the focus for our teaching the student and his problems. Every student has all sorts of problems more or less consciously in mind when he comes to a university. The laboratories books and instructors should exist as aids in the solution of those. Before he has gone far in his investigations, if laboratory, library and instructor are adequate, they will have led him out toward several other departments of the university, and a continuously increasing number of other problems will be tempting him on.

The lecture, the quiz, the laboratory manual, the text-book must be tools for the student rather than guides. The logical order underlying the text-book and lecture is that of a person with many years experience in a subject. The student approaches the subject in quite a different way, touching it at only a few, possibly unrelated, points. The logic of another, more experienced mind lacks significance for him. He needs to evolve his own orderly arrangement of the subject. That is all he can, as yet, comprehend. The laboratory manual, with its arbitrarily selected experiments, is similarly objectionable; it starts not with the student's problems, but with imposed problems. No lecture, or text-book, or laboratory manual exactly fits any one's needs. The quiz as at present conducted, instead of being used even as Socrates used it to lead up to some definite idea, or instead of its being, as it ought to be, a frank give and take between coworkers, has become merely insulting.

In place of these must be substituted the laboratory, reference books, private consultation with the instructor, group discussions, and an occasional supplementary lecture. This means merely that the university exists for the student, be he called student or instructor, twenty years old or seventy, modest scientist or titled grandee. It means that the older student is to see that the younger student has what he needs to work with, that he can find the reference books he needs, that he has access to the more complete experince of this elder whenever his problem seems to require experience greater than he has at his own command. It means that instead of memorizing facts for possible future use, the student is already at his life business of solving problems, the business he began, by the way, in the cradle. The group discussion will, of course, be based on the problems that have arisen in the laboratory, will be reports of laboratory work, and will relate the knowledge gained there with other sciences or other aspects of the same science. And now and then, there may be a lecture by a visiting scientist on his specialty. There is, of course, gain rather than loss in the instructor's reporting from time to time his own research work, or some particular interest, or bibliographic suggestions, just as the other students do. Such reports will give the younger students greater acquaintance with the instructor's point of view than they could get, perhaps, merely through conversations. But in such reports the instructor takes his place as a fellow student, not as a superior. Laboratory, reference books, a more experienced scientist to consult, occasional exchange of ideas with groups of fellow workers, these are all our incipient scientists need.

For three years the experiment was made in a scientific department of one of our middle western universities of teaching by the method just suggested, so far as that could be done under the conditions that exist in every university at present. All the courses in the department were so conducted, the students ranging in rank from freshmen to graduates, and numbering usually about twenty to the course.

At the beginning of each course there were

conferences with the students, who had registered for the work, to find out why they were there, what contact they had already had with problems in this subject, what points they expected the course to clear up for them. They were asked to prepare a rough outline of the subject, limited though their knowledge was, and from this outline their laboratory work was begun, so that they began with the points of contact previously made with the subject, and were already at work organizing what slight knowledge they had.

Each student's laboratory work was made at all times the center of his activity; it was starting point and unifying element. The questions that arose in the student's mind during his laboratory work were the basis of laboratory conversations and class-room discussions. Most of the conferences on work took place in the laboratory, when problems arose. The class room was used in part for the discussion of problems that could not well be worked out in the laboratory because of lack of time or equipment. This discussion of more general problems and of investigations carried on by other scientists, though usually introduced by the instructor, was brought in when suggested by the laboratory work of the students. Each student presented, also, during this class hour, the results of his own research studies. And though many problems were individual in origin, some of them were, of course, related, and lent themselves well to group discussion. It is true the students were less interested in the discussion of each other's investigations than in their own; still, a problem that a fellow student feels vividly is more interesting than one imposed by an instructor. Nearly all work was done independently of both his fellows and the instructor, in so far as the student was able, unaided, to solve his own difficulties.

Most of the systemization of work was done in laboratory conversations between instructor and student. Such correlation was urged throughout the course. Attempt was made to order data as they accumulated. At the end of the course, this systemization was rounded out in a second outline of the subject the students prepared.

The students almost invariably floundered at first. They had grown so dependent on directions that for a time they could only with difficulty initiate work of their own. Gradually they came to understand what was expected and they became clearer as to what they themselves wanted. And as the course continued the method seemed to them increasingly desirable and successful.

There were difficulties and hindrances in applying the method, of course. Almost all of them came from having to fit it into the regular university system. It couldn't be adopted wholeheartedly because of the regular schedule; and when work was prescribed in all other courses and enforced by examinations, there was a tendency, naturally, to slight a more flexible course.

And it is difficult to persuade a student one is really interested in his opinions when all through his home and school life independent thinking has been discouraged as inconvenient. But probably it is better to save him at the eleventh hour than let his power to think be dammed forever. It certainly seems absurd to dictate all details of work to the undergraduate and expect the graduate student suddenly to manifest originality, initiative and creative power. The method of the little child and the graduate student should not be interrupted by the years of directed mental effort our present school system imposes, should not because it is inefficient, and so fatiguing as to be almost disastrous. It is equally important that the beginnings of a science be taught by the scientific method as that graduate work be so carried on. For the early years in any science should be given largely to discovery and original research, as are the early years of childhood. Thinking and first-hand contact would better come early, else they may never come.

The difficulty of handling many students in this way is more fancied than real. One can not, of course, believe it possible to know and develop individually as many students as one

can lecture at. But if lecturer, laboratory assistants, quiz aides combined and divided the entire group in any department, students would develop more power than under the present method. They might not come in contact with as many facts, but they would retain more of those they did become acquainted with, and their power of thought would be much greater. We have probably swung to an extreme anyway in paying large salaries to a few lecturing departmental heads; we should have a better faculty and consequently a more creative generation of scientists developing if we spread our resources more equably over the entire teaching force.

A few other objections to the method one always expects to encounter in any discussion of it: that students are purposeless and lazy; they must have their work planned for them and be held or driven to it. They are children. Yet an unspoiled child is purposeful. And even if a freshman is somewhat dulled by his previous training, that seems scarcely a good reason for going on with the dulling process.

One hears, too, that the years of preparation are so short and the facts of knowledge so many it is the business of the instructor to organize material into simple form, easy to memorize, and give it to the students in lectures or text-books. Of course if a university chooses to do this inferior sort of work, training accurate automata instead of turning out thinkers, that is, presumably, its privilege. One wishes, though, there were some place students who didn't choose to become automata could go. So little of life is lived at the conscious level, and it is primarily from that part of life that progress is obtained, it seems a pity to shorten a man's real living and limit his contribution by discouraging living at that higher level.

Another objection that is subconscious rather than expresed is that the method requires rather more self restraint and mental flexibility than most instructors feel equal to.

Whether or not it seems worth while to excavate beneath the crust of indifferenece formd in self-defense during the preparatory years of prescribed work will depend on the value one places on creative thinking. Perhaps it does not seem to every one our greatest natural resource; but such an one is probably not himself very creative.

It is frequently contended that under such a method of teaching a student will lack system and an orderly grasp on the whole subject. The amount of systemization of knowledge will undoubtedly vary among free students; some orderly arrangement of material there must be. But the creative mind is less intent on classifying data than in gathering more, and in projecting new theories. It cares less to make of itself a card index of the literature on any subject than to "push forward the boundaries of knowledge."

The real rock on which the method is likely to founder, however, is the executive mania for definite classification of mentality. We must rule out variations from the medium. We must know in just what stage of development each student's mind is—or rather, at just what point in the assignment of the year's work he is. However could we give degrees? We can not be bothered with all this individualized education. We don't want thinkers anyway; we want followers.

None of these difficulties and hindrances greatly matter, once we are convinced of the need for developing creative thinkers in our scientific courses.

But it will require grace to step down from the lime light of the lecture platform, to cure ourselves of this contagion of text-book writing. We elders are so sure that out of our greater experience we can save our students effort and time. It is a clogging efficiency we seek. The greatest contribution we can make to a developing mind is to "stand out of its sunlight." And in the long run, that is the most efficient method; for individual initiative produces most in the least time, and produces it with a minimum of effort and friction. The problem we ourselves find is a fascination; the problem some one else sets us is a task. And our memory in the latter case is treacherously unreliable, while the knowledge

we worry out for ourselves is seldom forgotten.

C. G. MacArthur
Stanford University

LEVULOSE SIRUP

The present—and, we are told, very likely the permanent—shortage of crystallized sugar is stimulating very markedly the interest in other sugars. The consumption of glucose or corn sirup is increasing steadily; the making of sorghum sirup bids fair to return to the prominent place it once held; our friends the bees are being exploited more and more; and a great many breweries, instead of retiring as requested, are now malting grain as usual, but instead of fermenting it are converting it into maltose sirup. Of the above four sugar products, sorghum and honey are the only ones which compete with cane sugar in sweetness; maltose is much less sweet, and glucose is very much less sweet, than sucrose. Now, it is sweetness that we demand; we do not eat sugars and sirups primarily for their calories, but because they sweeten other, less palatable, and cheaper, food products. Therefore, glucose and maltose have very natural limitations on their extensive utilization, if sweeter materials can be found. Of the two sweeter products, honey will probably of necessity always remain a luxury; and sorghum sirup has a flavor that precludes its unlimited use for all purposes, although it should be said that this flavor can be almost entirely removed, with practically only the sweetness remaining, and that there is a possibility of an enormously increased utilization of sorghum in this way. Is there not, however, a sugar which is sweeter than any of the above, which is not now of commercial importance, but which possibly could be obtained in large enough quantities and at a low enough cost to become important?

Levulose, fructose, or fruit sugar, is the sweetest known sugar. Exact data as to the relative sweetness of the various sugars are not available, but it is often stated that levulose is 30 to 50 per cent. sweeter than sucrose. A levulose sirup, then, would be a distinct asset in the present commerce in sweet products. Levulose occurs in practically all fruits, is abundant in honey, and is found in appreciable amounts in sorghum sirup. Its most conspicuous occurrence in plants, however, is in the form of inulin in the tubers of the Jerusalem artichoke and in the bulbs of the dahlia. Inulin is a polysaccharide somewhat resembling starch, but whereas starch yields glucose on hydrolysis with acid, as in the manufacture of corn sirup, inulin yields levulose.

The inulin is present to the extent of 12 to 14 per cent. of the fresh tuber. As is well known, the artichoke gives very large yields, from 700 to 1,000 bushels per acre being normal. If one assume 40,000 pounds per acre, and a 10 per cent. recovery of inulin from the tubers, there would thus be 4,000 pounds of sugar per acre. A 50-bushel crop of corn yields about 2,000 pounds of starch; an acre of good sorghum yields about 1,600 pounds of sugar; an acre of sugar beets, 3,000 pounds; an acre of sugar cane 3,000 to 4,500 pounds.

Thus it is seen that the possible yield of sugar from artichokes compares very favorably with that of our other sugar crops; and the writer believes, on the basis of the above facts, that levulose sirup from artichoke tubers is one of the most promising sugar possibilities that we have. The levulose would probably have to be in sirup form, since it crystallizes with difficulty. The above figures are estimates based on known yields and analyses of artichokes. The unknown factor in the proposition at present is the technology of manufacture. Practically nothing is known about the isolation of the inulin and its hydrolysis to levulose on a commercial scale. But what is known concerning the chemistry of these substances gives us every reason to believe that the problem connected with the manufacture of levulose sirup could be solved, as were those in the manufacture of the other sugar products. Likewise the question of the cost of production is unknown. Since, however, the resultant product would be so much sweeter than any of the present sugars, it would be worth considerably more, and a greater cost of manufacture, if such should

be the case, would not necessarily be a handicap.

The usefulness of a levulose sirup is apparent. It would probably not be used alone as a sirup, but would be used for blending with other sirups to enhance their sweetness. Glucose and maltose sirups would be greatly improved if their sweetness were increased. And in the manufacture of soft drinks and confections levulose could very largely replace sucrose, and thus increase the amount of the latter that would be available as dry sugar.

In view of the above considerations, therefore, it is to be hoped that some institution, federal, state, or industrial, will see fit to inaugurate investigations on the production of levulose sirup from the Jerusalem artichoke, in order to augment our present sources of sweetness.

J. J. Willaman

University of Minnesota

RESOLUTIONS OF THE PAN-PACIFIC SCIENTIFIC CONFERENCE

V. Geology

1. *Geological Maps*

In the interest of science be it

Resolved, That the following maps of the Pacific region on the international scale of 1:1,000,000 be prepared as expeditiously as possible:

(*a*) A base map showing by contours or hachures as many topographic features as practicable.

(*b*) A map showing geological formations or groups of geological formations.

(*c*) A map showing mineral resources.

2. *Geological Surveys of Critical Insular Areas in the Pacific Ocean*

(*a*) Geological Survey of Easter Island

Since a knowledge of the geology of Easter Island might throw light on the question of whether there was in past geological time a westward extension of the land area of South American continent, be it

Resolved, That it is desirable to have a careful study of Easter Island to determine the character and geologic age of the rocks composing that island.

(*b*) Geological Survey of the Hawaiian Islands

Since the results of a detailed geological survey of the Hawaiian Islands would aid in the solution of many problems of the Pacific region, be it

Resolved, That this conference strongly recommends that a geological survey of the Hawaiian Islands be made and that appropriate geological maps and descriptive texts be published.

(*c*) Geological Survey of the Several Small Islands in Eastern Fiji

Since raised coral atolls with exposed basements of bedded limestone or of volcanic material are found in eastern Fiji, and since a geological survey of these islands supplemented by reconnaissance work in the neighborhood of Suva would be invaluable in the study of the origin of coral reefs, and in elucidation of the geology of the southwest Pacific, be it

Resolved, That a topographic and geological survey of the several small islands, such as Mango, Thithia, Lakemba, Vanua Mbalavu and Tuvutha be made at the earliest opportunity, and the results published.

3. *Form of Ocean Bottom*

Because of their importance as supplements to geological work on land in determining the structural framework of the Pacific region and in interpreting the geological history of the region, be it

Resolved (*a*), That the configuration of the bottom of the Pacific ocean be determined with adequate accuracy.

(*b*) That charts of the littoral and sub-littoral zones be made in all practicable detail, for example, wherever possible these charts should be on scales ranging between 1:10,000 and 1:40,000.

4. *Post-Cretaceous Correlation*

Since such knowledge is essential to the establishment of an adequate basis for the stratigraphic correlation of the post-Cretaceous formations of the Pacific region, be it

Resolved (*a*), That in addition to the study of the post-Cretaceous stratigraphy and paleontology of the Pacific islands and of the land areas on the margins of the Pacific Ocean, that such work also be expedited in the Caribbean region, and in the region from Burma through the Himalayas to the Mediterranean Sea.

(*b*) That inventories of the living fauna and flora of the Pacific region be prepared at the earliest practicable date.

5. *Studies of Subaerial and Submarine Erosion*

Since it is coming to be recognized generally that a knowledge of subaerial and submarine erosion is indispensable to a correct interpretation of the history of the continents, the continental margins, and the oceanic islands during post-Cretaceous time, be it

Resolved (*a*) That geologists, geographers, seismologists, biologists and others who are interested in the facts of form within the Pacific Ocean and along its margins devote attention to the study of physiographic processes and the forms resultant from such processes.

(*b*) That geologists and physiographers make special study of the physical, chemical and other properties of igneous and sedimentary rocks so as to ascertain the difference in their resistance to erosive agents.

(*c*) That efforts be made to obtain assistance in furthering the study of such important agents as wave and current erosion, factors limiting wave base, the action of weathering and corrosive agents at the headwaters of streams, the forms of stream channels, the form of sea cliffs at different stages of development, the action of plants in retarding land erosion, and the sequential stages of erosion of fault scarps.

6. *Studies of Sedimentary Processes and Sedimentary Rocks*

Since it is generally recognized that the interpretation of a large part of the geological record demands a knowledge of the processes and the results of these processes in the formation of deposits of past geological time; therefore be it

Resolved (*a*) That geologists, oceanographers, geographers, biologists and others who may be interested devote as much attention as possible to the study of modern sediments and the processes by which they are formed.

(*b*) That geologists make special studies of the physical, chemical and other properties of sedimentary rocks to ascertain the conditions under which the deposits were formed and the changes that may have taken place in such sedimentary rocks after deposition.

(*c*) That all existing agencies be urged to study the phenomena referred to in paragraphs (*a*) and (*b*) above, and that efforts be made to increase the number of agencies for the prosecution of such investigations.

6. *Geological Cooperation*

Since it is desirable that the projects undertaken by the different workers in the Pacific region be so selected and so designed that each may be supplementary to the rest and so contribute to the uniform accumulation of geological information concerning the Pacific region, be it

Resolved, That steps be taken to advise in the planning of research to correlate the efforts of the different workers, and to promote in such ways as may be proper a uniform mode of publication of results.

VI. Seismology and Volcanology

The dominant motive which has appeared in the convention of seismologists and volcanologists of the Pacific here gathered together for the first time, has been to promote more localized and more continuous observation of regional phenomena than has hitherto been accomplished in most seismic and volcanic districts. On the other hand, there is agreement that precise teleseismic triangulation is not a field for amateurs or for stations equipped with a multiplicity of inferior and diverse instruments.

There is a crying need for mutual information, regularly supplied by each observer to his distant colleagues, concerning volcanic and seismic happenings in each land. The employment of mariners and scientific expeditions to

collect specimens and notes for the volcanologists in remote places may be organized.

Education of the people in matters of earthquake-proof construction and safeguards against disaster has been proved to be a practicable and effective method of meeting volcanic and seismic crises.

Interest has recently developed in the earth tide, changes of level about volcanoes and measurable horizontal and vertical displacements directly related to earthquakes. These are matters for the national geodetic surveys and for geophysical investigation of high mathematical precision.

The three groups of motives above enumerated, respectively, localized work, publication and education, and precise geophysics are the fundamenta on which the following seismologic and volcanologic resolutions of the conference are built.

1. *Establishment of Volcano Observatories*

Useful volcano experiment stations have already been established in some lands, and more volcanologic experience is needed for protection against disaster of the increasing populations of Pacific countries and for the advance of science; therefore this conference

Recommends the continuance of the present volcano observatories and the establishment of new permanent volcano observatories in lands about the Pacific; and recommends that such a station for maintenance and publication of continuous observations should be placed on one of the more active volcanoes in each important volcanic district.

2. *Promotion of Localized Seismometry*

In addition to the work of existing establishments, the intensive study of both large and small earthquakes in seismic provinces by all appropriate physical, geological and other scientific methods may lead to important and rapid advancement in geophysical knowledge. This knowledge is of importance for economic and humanitarian as well as scientific ends. This conference therefore

Commends the existing institutions, recommends their continuance and expansion, and urges early establishment of further specific programs of investigation and continuous observation in regional seismology, in special seismic districts about the Pacific. Timely publication of results is recommended. Moreover this conference recommends to the National Research Council of the United States the establishment of a program of research in regional seismology in the southwestern part of the United States.

3. *Publication of Volcano and Earthquake Information*

The workers in regional seismology and volcanology need accurate information about geophysical events in other localities than their own; therefore this conference

Recommends that prompt and authoritative publication of current facts and measurements concerning volcanoes, earthquakes, submarine eruptions and tidal waves be an essential part of the routine of all Pacific observatories.

4. *Precise Leveling and Triangulation in Relation to Volcanology and Seismology*

Great earthquakes and volcanic eruptions are often preceded and followed by elevations, depressions and horizontal displacements in the regions concerned; therefore this conference

Recommends that precise leveling and triangulation be carried on at definite time intervals, in selected seismic and volcanic districts, in order to ascertain precursory and other changes in underground stress accompanying great seismic and volcanic disturbances.

5. *Collection and Publication of Statistics of Earthquakes and Eruptions*

There is needed for certain Pacific countries more complete statistics concerning earthquakes and eruptions; and a complete list for the world should be eventually maintained; therefore this conference

Recommends that each Pacific country publish statistical lists of local eruptions, earthquakes, tidal waves and other related phenom-

ena; and issue catalogues of active, dormant and extinct volcanoes, and of local seismic features.

6. *Central Scientific Bureau*

Dissemination of volcanologic and seismologic knowledge will be furthered by working through a body cooperating with all Pacific countries; therefore the conference

Recommends the establishment of a central bureau for dissemination of scientific knowledge among the volcano and earthquake stations of the Pacific.

7. *Geophysical Samoan Station*

This conference commends highly the work done at the Geophysical Observatory at Apia, Samoa; and expresses the hope that the service of that station will be continued.

8. *Education of Dwellers in Districts Liable to Disaster*

Great injury and loss of life to persons and damage to human constructions may be caused by earthquakes and volcanic eruptions and may be decreased by general education; therefore this conference

Recommends that countries liable to seismic disaster educate the people in proper methods of construction, in behavior during emergencies, and in the history of such catastrophes elsewhere.

SAMUEL SHELDON

DR. SAMUEL SHELDON, of the Polytechnic Institute of Brooklyn, died at Middlebury, Vt., of Bright's disease on September 4, 1920. He was a professor of physics and electrical engineering at that institution for the last thirty-one years, and enjoyed a wide reputation as a physicist, educator and consulting engineer. In appreciation of his services to the Polytechnic, his colleagues of the faculty and the members of the corporation at recent meetings adopted the following minute:

The corporation and the faculty of the Polytechnic Institute of Brooklyn desire to give expression to the great loss sustained by the death of Dr. Samuel Sheldon who for thirty-one years served the Polytechnic as professor of physics and electrical engineering.

As an educator he was beloved and admired for his sterling qualities of mind and heart, for his earnestness and enthusiasm in the lecture-room, and for his genial good humor on all occasions. The personal interest he held for his students followed them in their professional work, and he derived pleasure from their achievements. They in turn affectionately called themselves "His Boys."

As an engineer he attained eminence through his integrity and straightforwardness of character; and by forceful personality and keen judgment he reached the highest offices in national engineering societies. This broad contact with the engineering fraternity and his association with men of attainment brought him experience and vision of inestimable value to the Polytechnic.

As a colleague he will always be remembered as a man of action, of precision, yet sympathetic and kind—above all inspiring. He lived for the Polytechnic, worked unceasingly for its upbuilding, and was rewarded with the happiness that came through the realization of his ideals.

We, the members of the corporation and faculty of the Polytechnic Institute, herewith express to his family our deep respect and esteem for our beloved Dr. Sheldon and the profound regret that we shall henceforth be deprived of his valuable assistance and counsel in the solution of our educational problems.

Dr. Sheldon was born in Middlebury on March 8, 1862, the son of Harmon Alexander and Mary Bass Sheldon. He was graduated from Middlebury College in 1883 with the degree of A.B. and then pursued graduate work, receiving the degree of A.M. in 1886. During the next two years he studied at Würzburg, Germany, and received the degree of doctor of philosophy there in 1888. During a part of this time he was associated with Kohlrausch, the distinguished physicist, in his celebrated determination of the ohm as the unit of electrical resistance. He was awarded the honorary degree of doctor of science from the University of Pennsylvania in 1906, and from Middlebury College in 1911.

Dr. Sheldon was the author and joint author of several college text-books. Among them were "Direct-Current Machines," "Alternating-Current Machinery," "Electric Trac-

tion and Transmission Engineering" and "Physical Laboratory Experiments." He had also written a number of monographs and papers on special topics.

Dr. Sheldon was an honorary fellow of the American Electrotherapeutic Association, fellow and past-president of the American Institute of Electrical Engineers, member of the American Physical Society, member and past-president of the New York Electrical Society, member of the American Electrochemical Society, fellow of the American Association for the Advancement of Science, member of the Society for the Promotion of Engineering Education, member, past-vice-president and assistant treasurer of the United Engineering Society and chairman of its library committee, member of the Brooklyn Institute of Arts and Sciences and president of its department of electricity, and member of the Engineers' Club.

Erich Hausmann

SCIENTIFIC EVENTS

THE CALIFORNIA INSTITUTE OF TECHNOLOGY

The California Institute of Technology, Pasadena, California, opened the work of the new year on September 27. The name of this institution was changed from Throop College of Technology to its present name by order of court, on petition of the board of trustees, on April 7, 1920. From the fall enrollment, the total attendance for the year is estimated at 400 students, a substantial increase over the enrollment of last year, which marked the largest attendance up to that time.

The institute has just received from Dr. Norman Bridge an additional gift of $100,000, for the Norman Bridge Physical Laboratory. His original gift for this purpose was $150,000, this addition making a total of $250,000. The construction of the building will be commenced immediately, and the building will be completed for the opening of the college year 1921–1922.

The resignation of Dr. James A. B. Scherer as president of the institute was accepted by the board of trustees on September 11. Dr. Scherer was president of the institute for twelve years. His resignation was occasioned by the condition of his health. When Dr. Scherer assumed the presidency the institute occupied old buildings, its work was almost wholly that of a preparatory school, its endowment very small, and its staff little known in the educational world. To-day it is a scientific institution of recognized standing, it occupies a physical plant consisting of a beautiful campus of twenty-two acres and four modern, reinforced concrete buildings, beautiful in architecture and equipment with the most modern scientific equipment. It has a substantial and constantly growing endowment, and has drawn into its staff men of the highest standing in science and engineering, including such outstanding figures as Dr. Arthur A. Noyes, who has recently become a full-time member of the faculty, Dr. Robert A. Millikan, who, under a cooperative arrangement with the University of Chicago, spends a portion of each year at the institute, and Dr. A. A. Michelson, who as research associate of the institute has recently installed on its campus apparatus for the measurement of earth tides, and has recently spent several months at the institute in connection with this investigation.

Pending the appointment of a new president a faculty administrative committee has been appointed, composed of Franklin Thomas, professor of civil engineering, chairman, Dr. Arthur A. Noyes, director of chemical research, Clinton K. Judy, professor of English and chairman of the faculty, Harry C. Van Buskirk, professor of mathematics and recorder, and Edward C. Barrett secretary of the institute.

New appointments to the staff of the institution are:

John R. Macarthur, B.A., University of Manitoba, 1892; Ph.D., University of Chicago, 1903; associate professor of English.

Captain Frederic W. Hinrichs, U. S. A. Retd., West Point, 1902; B.A., Columbia University, 1902; assistant professor of mechanics.

Captain Hans Kramer, U. S. A. Engineers, West

Point, 1918; professor of military science and tactics.

Samuel A. Tenison, H.S., James Millikan University, 1914; assistant professor of physical education.

Roscoe G. Dickinson, S.B., Massachusetts Institute of Technology, 1915; Ph.D., California Institute of Technology, 1920; National Research Council Fellow; research associate in chemistry.

Clyde L. E. Wolfe, B.S., Occidental College, 1906; M.S., Occidental College, 1907; A.M., Harvard University, 1908; Ph.D., University of California, 1919; instructor in mathematics.

Ernest H. Swift, B.S., in chemistry, University of Virginia, 1918; M.S., California Institute of Technology, 1920; instructor in analytical chemistry.

Fred L. Poole, B.S., California Institute of Technology, 1918; M.S., Union College, 1919; instructor in electrical engineering.

Fred K. Converse, B.S., in mechanical engineering, University of Rochester, 1914; instructor in civil engineering.

Glen G. H. Bowlus, B.S., Purdue University, 1912; instructor in mechanical drawing.

James B. Friauf, A.B., University of Montana, 1918; instructor in physics.

THE HECKSCHER FOUNDATION FOR THE PROMOTION OF RESEARCH AT CORNELL UNIVERSITY

THE committee on general administration of the Cornell University board of trustees, on October 2, adopted a plan for the administration of the income from the Heckscher Foundation for the Promotion of Research in Cornell. August Heckscher gave Cornell University $500,000 last summer as an endowment to promote research. The plan of administration is described in the following resolutions which the committee adopted:

That the income shall be used only for the promotion of research, including the publication of the results thereof.

That for the present the income shall not be used for permanent research professorships.

That the income shall not be used to increase the emoluments of any member of the teaching staff.

That the income shall not be used intentionally to promote investigation leading to patent rights or to the pecuniary benefit of the investigators through patent rights, or in any similar manner.

That for the administration of the foundation there be established a council to be known as the Heckscher Research Council. This council shall consist of the president of the university, *ex officio*, as chairman; two trustees to be elected by the board of trustees whose respective terms as members of the council shall continue until the expiration of their then respective terms as trustees; the dean of the graduate school, *ex officio;* four members of the university faculty, two from each of the two groups known as the group of sciences and the group of letters as specified in Section 2 of Article XII. of the university statutes and relating to the university library; and two emeritus professors to be selected annually by the council.

The terms of the four faculty members to be elected by the groups of the faculty shall, at the first election, be for one, two, three and four years, respectively, and thereafter the term of each shall be four years.

All members of the council shall continue to hold office until their successors are elected.

This council shall, subject to the approval of the board of trustees, have general supervision of research under the Heckscher Foundation, the expenditure of the income of the fund, and all other matters pertaining thereto. The council shall report its recommendations from time to time to the board of trustees and upon the approval of the same the expenditure of appropriations shall follow the usual practise of the university.

The council shall call annually for requests for grants from individual investigators, or groups of investigators proposing to collaborate, but not from departments of the university as such, nor from colleges.

The council shall have power to establish and from time to time modify the rules and regulations governing its meetings and the details of appropriations.

The annual report of progress shall be made to the council by each investigator or group receiving a grant. An annual report to the board of trustees shall be made by the council and a copy thereof sent to the founder of the fund. A minimum of one hundred copies of all publications of the results of the investigations shall be delivered to the council for preservation in the university library and distribution under the direction of the council. A bound copy of such publications shall from time to time be transmitted to the founder.

AUSTRIAN METEOROLOGISTS APPEAL FOR AID

SEVERAL pathetic appeals from Austrian meteorologists or their families have been

received recently by a number of American meteorologists. The following one came to the editor of the *Monthly Weather Review* on October 6:

ZENTRALANSTALT
FÜR
METEOROLOGIE UND GEODYNAMIK.
Wien XIX Hohe Warte 38.

20 September, 1920.

In view of our calamities in Austria, I beg you to help my colleagues, the members of the staff of the Zentralanstalt für Meteorologie in Vienna, in their great need of food. The American Relief Administration Warehouse has published the following circular.

> For several weeks the American Relief Administration Warehouses in Austria have been delivering food parcels to holders of food drafts. You can buy at any bank in the United States American Relief Warehouse Drafts and send them to us in Vienna. On presentation of these food drafts at the warehouse in Vienna, we can also draw American food. We are in great need of food in Austria. Individual food parcels sent from America usually do not reach us. Money does us no good when there is no food to buy. Help us in our distress by sending an American Relief Warehouse Food Draft—quickly! For further information apply to American Relief Administration, 115 [present address, 42] Broadway, New York City, or to your own or the nearest bank.

Allow me to draw your attention to it. We are, the families included, 67 persons. We all would thank you very heartily for your kindness.

I am, dear Sir yours very respectfully,

DR. MORIZ TOPOLANSKY, *Secretary*

Contributions whether to a general fund or for any specific class or individual may be sent direct to the American Relief Administration 42 Broadway, New York City. If any further information as to the general situation among the intellectual classes in central and eastern Europe is desired, it may be had from Dr. Vernon Kellogg, National Research Council, Washington, D. C.

A fund for the purchase of food drafts for Austrian meteorologists in the name of the American Meteorological Society has been started by some members of the society. Contributions toward this fund may be sent to Charles F. Brooks, Secretary, Weather Bureau, Washington, D. C.

THE GILMAN MEMORIAL LECTURES ON GEOGRAPHY

THE Johns Hopkins University announces the inauguration of a course of lectures to be known as The Gilman Memorial Lectures on Geography. These lectures are made possible through the generosity of the family of Daniel Coit Gilman, first president of the Johns Hopkins University. Dr. Gilman began his teaching career at Yale (1863–72) as professor of physical and political geography and was a member of the U. S. Commission on the boundary line between Venezuela and British Guiana in 1896–97.

The first series of lectures will begin October 18, and will continue weekly, throughout the academic year. They will be given by Major Lawrence Martin, of the General Staff Corps, who as the chief of the Geographic Section, Military Intelligence Division, U. S. Army, attached to the American Commission to Negotiate Peace, had unusual opportunities for studying at first hand the geographical factors affecting trade in the reorganized states of Europe, Asia Minor and the Caucasus.

SCIENTIFIC NOTES AND NEWS

AT the sixth International Congress of Mathematicians, held at Strasbourg at the end of September, addresses were given by Sir Joseph Larmor, Professor L. E. Dickson, M. de la Vallée-Poussin, M. Volterra and M. Nörlund.

THE Botanical Society of Washington has elected the following officers for the ensuing year: *President,* Charles E. Chambliss; *Vice-president,* P. L. Ricker; *Recording Secretary,* Roy G. Pierce; *Corresponding Secretary,* R. Kent Beattie; *Treasurer,* L. L. Harter.

THE Italian government has conferred upon Dr. Leonard Hill, F.R.S., the Italian silver medal "Ai Benemeriti della Salute Publica."

THE Council for Scientific and Industrial Research of Canada has awarded $5,000 to as-

sist Professor J. C. McLennan, of Toronto University, in investigations on helium to determine the uses for lamps, amplifying values, high resistances, etc.

The Paris Academy of Sciences has awarded the L. Lacaze prize (10,000 francs) to Dr. Maurice Arthus, professor of physiology at Lausanne.

Dr. Charles F. Chandler, formerly professor of chemistry and dean of the school of mines at Columbia University, received the honorary degree of doctor of science from Union College last June. In conferring the degree, Dr. Charles A. Richmond, chancellor of the university, referred to Professor Chandler in the following language: "Author of many chemical papers; member of many scientific and learned societies both here and abroad. The recipient of distinguished academic honors from universities in America and England. Esteemed by your profession, beloved by generations of grateful students to whom you have imparted both knowledge and wisdom. We delight also to do you honor."

Dr. Robert M. Yerkes, chairman of the Research Information Service of the National Research Council, and Dr. Leonard C. Gunnell, of the Smithsonian Institution, in charge of the Regional Bureau for the United States of the International Catalogue of Scientific Literature, have gone to London to represent these organizations at a conference upon the future of the International Catalogue of Scientific Literature which was held on September 28. Dr. L. E. Dickson, professor of mathematics in the University of Chicago, and Dr. Luther P. Eisenhart, professor of mathematics in Princeton University, who have been in attendance at the organization meeting of the International Mathematical Union at Strasbourg and Dr. S. I. Franz, who has been in Europe this summer, will also attend the conference in London, Dr. Dickson representing the National Academy of Sciences and Dr. Eisenhart and Dr. Franz as additional representatives from the National Research Council.

Dr. John J. R. Macleod, Toronto, professor of physiology in the University of Toronto, and vice dean of the medical faculty, is chairman of the Committee on Industrial Hygiene in Canada. With him are associated Professor Archibald B. Macallum, members of departments of physiology and psychology in various universities in Canada, and one representative each of the department of labor, Ottawa, of industry, and women's organizations. A secretary of the committee is established in the medical department of the University of Toronto.

Professor John Bretland Farmer, F.R.S., of the Imperial College of Science and Technology, has been appointed a member of the advisory council to the Committee of the British Privy Council for Scientific and Industrial Research.

Professor Vladimer Karapetoff, of Cornell University, has been nominated for state engineer and surveyor on the socialist ticket.

Mr. B. L. Johnson, geologist, has been appointed acting chief of the Foreign Section of the Mineral Resources Branch of the U. S. Geological Survey, in the absence of Mr. Eugene Stebinger.

Dr. William L. Tower, captain, U. S. A., formerly associate professor of zoology in the University of Chicago, after his return from the army of occupation in Germany and discharge in the summer of 1920, sailed on September 25 for Tampico, Mexico, to assume the directorship of the pathological, bacteriological and x-ray laboratories of the American Hospital, Tampico.

The resignation of Professor Ernest Blaker, of the department of physics, Cornell University, has been accepted. Professor Blaker has been on leave of absence since the closing of the Aviation School two years ago, when he went to Akron, Ohio, to accept a position with the Goodrich Tire and Rubber Company.

William A. Bevan, formerly assistant professor of physics at the Oregon State Agricultural College, who has been a first lieutenant in the air service since February, 1918, has been appointed a captain in the air service

of the regular army. He is now chief inspector of airplanes and motors in the Aviation Repair and Supply Depot at Rockwell Feld, Coronado, California.

Dr. Henri M. Ami, who has been in Washington at the British Embassy for the last four years, is leaving that post to resume his work at Ottawa, Canada, in connection with the Geological Survey of Canada, Department of Mines. During his stay at the capitol Dr. Ami was asked to take charge of war metals and minerals and derivatives, and is now returning to Canada to devote his time to paleontology and chronological geology in which he was formerly engaged.

Neil M. Judd, curator of American archeology, U. S. National Museum, returned to Washington on October 1 after having spent the preceding five months in Utah, Arizona and New Mexico, engaged in archeological investigations for the Bureau of American Ethnology and the National Geographic Society.

Dr. Jacques Loeb, of the Rockefeller Institute for Medical Research, delivered the first of the Harvey Society Lectures at the New York Academy of Medicine, on Saturday evening, October 6. His subject was "The proteins and colloidal chemistry."

The Cutter lectures on Preventive Medicine and Hygiene will be given on October 19 and 20 in the Harvard Medical School from five to six P.M. by Dr. Theobald Smith, director of the department of animal pathology of the Rockefeller Institute for Medical Research, Princeton, N. J., on "Medical research and the conservation of food-producing animals."

At a special meeting of the Cleveland Academy of Medicine, October 8, Dr. Harvey Cushing, Moseley professor of surgery at Harvard University, surgeon in chief of the Peter Bent Brigham Hospital, Boston, delivered an address on "The Special Field of Neurological Surgery."

The Harveian Oration before the Royal College of Physicians of London will be delivered by Sir Frederick Andrewes, M.D., F.R.S., professor of pathology in the University of London and pathologist to St. Bartholomew's Hospital, on October 18.

The first Murphy Memorial Oration of the American College of Surgeons was delivered by Sir Berkeley Moynihan on October 11 during a meeting of the College in Montreal. The oration has been founded in honor of the late Dr. J. B. Murphy, of Chicago. On the same occasion Sir Berkeley Moynihan presented to the college a mace, the gift of the surgical consultants of the British Army during the war.

By the will of Mrs. Jones an oil portrait of the late Professor George W. Jones, for years a teacher of mathematics at Cornell University, has been bequeathed to the university.

The New York Academy of Medicine has received a cash bequest of $5,000 and a library valued at $4,567 in accordance with the conditions of the will of the late Abraham Jacobi.

Frederick Henry Gerrish, emeritus professor of surgery in the Medical School of the University of Maine, died on September 9, aged seventy-five years. After serving as lecturer and professor of therapeutics, materia medica and physiology at the University of Michigan, Dr. Gerrish returned to his alma mater in 1875 as professor of materia medica and therapeutics. He became professor of anatomy in 1882.

Adolph Gehrmann, emeritus professor of bacteriology and hygiene in the College of Physicians and Surgeons, Chicago, died on October 3, at the age of fifty-two years.

A correspondent writes that Dr. F. Hasenöhel, professor of physics at the University of Vienna, successor to the well-known physicist Boltzmann, was killed in action in the autumn of 1915.

The United States Civil Service Commission announces that the Coast and Geodetic Survey is in need of junior engineers and deck officers and that an examination will be held on December 8 and 9. The entrance sal-

ary offered is $2,000 a year, which will be increased to $2,240 a year after one month of satisfactory service.

THE twenty-fourth Congress of Alienists and Neurologists of French-speaking Countries was held recently at Strasbourg under the presidency of Dr. Dupré, clinical professor of mental diseases at the Paris medical faculty.

WE learn from *Nature* that Mr. J. J. Joicey has acquired for the Hill Museum, Witley, the collection of Lepidoptera formed by Mr. H. J. Elwes, as well as the large collection of Heliconius formed by the late H. Riffarth. The museum has lately also received large collections of Lepidoptera from Central Africa, obtained by Mr. and Mrs. T. A. Barns, who have recently returned from a twelve months' trip undertaken on behalf of Mr. Joicey.

THE U. S. Public Health Service has established at Pensacola a research station for the study of bubonic plague. A number of trained experts in addition to those already on duty in Pensacola will be detailed to that city. Additional research equipment will be provided to facilitate their investigations.

RESEARCH work on the manufacture of oxygen from the engineer's point of view began at the Harvard Engineering School early in the summer under the direction of Dr. Harvey N. Davis, professor of mechanical engineering. The National Research Corporation, founded in 1912 through the efforts of Dr. Frederick G. Cottrell, now director of the U. S. Bureau of Mines, has given Harvard $5,000 for the work. Professor Davis and his associates have undertaken to determine the fundamental data concerning air and its properties, believing that present methods of making oxygen are wasteful, and that the industrial use of oxygen in blast furnaces may result from the elimination of this waste. In return for its backing, Professor Davis has agreed to turn over to the Research Corporation any patents that may develop from his work.

SECRETARY MEREDITH has announced a reorganization of the publication and information work of the Department of Agriculture, and the appointment of a director of information to have general supervision of all these activities, both in Washington and in the field. He has named E. B. Reid, formerly chief of the Division of Publications, to the new position. Mr. Reid's relation to the work will be similar to that formerly held by Assistant Secretary Ousley, who had charge of such activities during the war period. Harlan Smith, formerly in charge of the Office of Information, has been appointed chief of the Division of Publications. The work now being performed by the Office of Information hereafter will be known as the Press Service, which will be in charge of Dixon Merritt, and will continue under the immediate direction of the chief of the Division of Publications. The director of information will bring about closer coordination of the information and publication work of the various bureaus with that of the Division of Publications and will be charged with formulating and executing plans for developing and improving the information service of the department as a whole to the public.

Nature reports the forthcoming establishment in the University of Paris of an Institute of Psychology. The institute will be administered by a council composed of Professors Delacroix, Dumas, Janet, Piéron, and Rabaud, and the deans of the faculty of letters and sciences. It will afford instruction, both theoretical and practical, in general, physiological, experimental, pathological and comparative psychology. To it will be attached the recently established Institute of Pedagogy, forming its pedagogical section. Other sections of the institute, dealing with the general applications of psychology and with vocational selection, will be formed shortly. The institute will grant diplomas to successful students in each of these sections and to those who, after attending other courses of instruction, have passed the examinations therein. It will also be open for research work in connection with the university doctorate or higher diplomas. Previously Professor Janet with his colleague, Professor Dumas, worked in psychopathology quite in-

dependently of the late Alfred Binet, who directed the psychological laboratory. Professor Piéron, Binet's successor, is now joining forces with the representatives of French pathological psychology, and the institute thus formed is also to encourage the applications of psychology to education and to industry.

UNIVERSITY AND EDUCATIONAL NEWS

THE will of the late Jacob Schiff includes the following bequests:

To the Montefiore Home and Hospital for Chronic Diseases	$300,000
To the Jewish Theological Seminary of America	150,000
To the Hebrew Union College at Cincinnati	100,000
To the New York University for its School of Commerce and Accounting	50,000
To the Metropolitan Museum of Art	25,000
To the New York Public Library	25,000
To the Zoological Society of the City of New York	25,000
To Harvard University	25,000
To Tuskegee Normal and Industrial Institute	10,000
To Hampton Normal and Agricultural Institute	10,000

AT the Medical School of the Johns Hopkins University at least two years of college work, of which one and one third years should be devoted to inorganic and two thirds of a year to organic chemistry, will hereafter be required. Each year's course comprises three class room exercises a week and five to six hours of laboratory work. This represents only a minimal training, and three years' work is advised, including one third of a year devoted to lectures and demonstrations in elementary physical chemistry. After 1923 three years' preparation in chemistry will be required, including at least 240 hours of class room work and 500 hours of laboratory work. The former must include 60 hours in organic chemistry and a short course in physical chemistry; while the latter must include one year's work in quantitative analysis and 120 hours in organic chemistry.

OWING to the death of Alfred J. Moses, professor of mineralogy at Columbia University, the department of mineralogy has been combined with that of geology into a single department of geology and mineralogy. Dr. Lea I. Luquer, now assistant professor of mineralogy has been promoted to be associate professor.

PROFESSOR WILLIAM J. CROZIER, of the department of zoology of the University of Chicago, has been appointed professor of zoology and public health at Rutgers College.

DR. HOMER H. COLLINS, head of the department of biology of the Fresno Junior College at Fresno, California, has become assistant professor of zoology in the University of Pittsburg.

MR. JOHN PAUL GIVLER, after two years service in the Sanitary Corps, has accepted the headship of the department of biology at the North Carolina College for Women, Greensboro, N. C.

CONRAD THORALDSEN and Isaac Neuwirth have been appointed instructors in the departments of histology and of physiological chemistry, respectively, of the New York Homœopathic Medical College and Fowler Hospital.

ALBERT SALATHE, graduate student in the University of Chicago, has gone to Albany, New York, to be professor of chemistry at the Albany College of Pharmacy.

PROFESSOR E. H. KRAUS, head of the mineralogical department of the University of Michigan, has been made acting dean of the college of pharmacy until a new dean is appointed. Dr. Kraus has for many years been dean of the University of Michigan Summer Session. Mr. Charles G. Stocking has been appointed assistant professor of pharmacy to fill the vacancy caused by the resignation of Professor A. F. Schlichting, who has taken up his work as chief of the Control Laboratories of the William B. Warner Company of Saint Louis.

IN the department of geology, University of Kansas, Dr. Raymond C. Moore, professor of geology and paleontology and state geologist, has been made chairman; Professor Chesley J. Posey, of the University of Minnesota, has

been appointed associate professor of geography; Professor Russell S. Knappen, of the University of Chicago, has been appointed assistant professor of economic geology, and Dr. Walter H. Schoewe, of the Colorado School of Mines, has been appointed assistant professor of geology. Dr. Winthrop P. Haynes, associate professor of geology, is absent on leave and will undertake for the Standard Oil Company of New Jersey explorations in northern Mexico.

AT the Carnegie Institute of Technology new appointments have been made as follows: In the division of science and engineering are C. R. Clutter, Lauren C. Hand and Frank E. Rupert, instructors in chemical engineering; R. W. Boreman, W. H. Michner and A. Press, instructors in physics; Charles A. Blodgett and Fred J. Evans, instructors in civil engineering; W. S. McKee, instructor in machine design; David C. Saylor, instructor in mechanical engineering; W. A. Copeland, instructor in metallurgical and mining engineering, W. Z. Price, assistant professor in mining engineering, and C. G. Simpson, instructor in the mechanics department. In the division of industries are Charles B. Walker and F. N. Talley, instructors in chemistry, and James Creech, instructor in press work, in the printing department.

DISCUSSION AND CORRESPONDENCE

AN INSTITUTION FOR TROPICAL RESEARCH

TO THE EDITOR OF SCIENCE: The immense importance of the tropics and of tropical products to the future of industry is being more and more widely recognized. The most rapid developments of the future will inevitably lie to the southward since only there can now be found unlimited, unused opportunity. The greatest volume of trade must ultimately flow north and south rather than east and west since east and west have in the main similar products while those of north and south are complementary. The necessity for a much more accurate and extensive knowledge of tropical conditions, products and resources is being realized by many.

Concrete plans for an American institution devoted to tropical research seem first to have been suggested in the Philippines, where such tremendous strides have been taken along these lines since the American occupation of these islands. Director Arthur F. Fischer, of the Philippine Bureau of Forestry, and Dean C. F. Baker, of the College of Agriculture, have been particularly active in this propaganda. When the Roosevelt Memorial Association was formed it occurred to the present writer that the foundation of such an institution would be a most fitting memorial to the memory of that strenuous advocate of the conservation of natural resources and explorer of tropical wildernesses. An outline for the organization of a Roosevelt Memorial Institution for the Study of Tropical America was accordingly drawn up and was submitted to the association but no favorable action was secured.

At the close of the war the National Research Council was organized from what had been the Council for National Defense. It is understood that the importance of tropical problems has been given due consideration by this body, and that committees have been appointed who have submitted reports but that so far no final action has been taken toward formulating a concrete plan for tropical work. The writer has no connection with the Council for National Research but his interest in everything relating to tropical problems is so great that he begs permission to submit the following for the consideration of this body:

OUTLINE FOR THE ORGANIZATION OF THE ROOSEVELT INSTITUTION FOR TROPICAL RESEARCH UNDER THE AUSPICES OF THE NATIONAL RESEARCH COUNCIL

1. This institution should be organized as a special section of the council with a permanent secretary and an office force to collate and index existing knowledge of tropical resources and conditions. A bibliographic card index should be made indicating in what libraries[1] given works can be consulted.

[1] The necessity for such information as this was forcibly brought home to the writer during a recent visit to the libraries of Washington and New

2. All workers should be registered who are able and willing to undertake tropical investigations. Men occupying regular positions can usually secure leave of absence to undertake special investigations in their respective lines. This register should include not only scientific workers in the United States but those from all parts of America and for that matter those from any other part of the world who would care to interest themselves in American problems.

3. Once such a list of available workers has been secured then let it be widely known to the different governments of the Pan-American Union that the institution is in a position to furnish the best attainable expert service, and to supervise all such governmental scientific projects as geological surveys, including special studies of mineral resources; forestry surveys, including suggestions for the utilization of existing forest products and the reforesting of denuded areas; physiographic surveys; archeological studies; faunal or floral studies; special industrial problems; or the investigation of plant diseases, injurious insects or other special agricultural problems.

At the present time when really competent investigators are hard to obtain, the temporary services of the highest class of experts, vouched for and supervised by such an institution, should be very attractive to the governments concerned. The exact form of agreement with the institution and with individual workers could be determined independently in each case. The investigators might receive temporary appointments as officials of the interested governments and their reports be published as official documents by such governments, or any other arrangement could be made that would be mutually satisfactory.

4. In like manner it should be made known to the different industries dependent on tropical products that the resources and personnel of the institution were at their service for the study of any of their special problems. Many of these industries now maintain their own extensive research departments, but the ability to call in the highest possible class of additional expert advisers would doubtless be appreciated, especially in cases of unusual emergency.[2]

As a case in point the United Fruit Co. has for years been suffering heavy losses from the ravages of the banana wilt disease on some of their extensive Central American estates. Their early attempts at hiring expert advisers proved unfortunate, no workable remedies having been suggested by the pathologists employed. As a consequence banana planting has been abandoned on large areas and expensive railroad and other equipment is lying idle. It seems to be a case that is not soluble by ordinary pathological methods. If a council of experts had been available bringing a broader viewpoint to bear on the problem it is likely that some practical solution could long since have been arrived at with great financial advantage to the company. Long range advice without personal investigation is always risky, but in this case the most obvious method for combating banana wilt would seem to be to plant these lands in sugar cane for a term of years. This crop is adapted to banana lands and it would fully utilize the railroad and other equipment. After the wilt fungus had died out of the soil (requiring an unknown number of years) a portion or all of the lands could be again planted to bananas, if that seemed desirable while other lands less well adapted to bananas could be planted to cane to keep up a supply for the mills.

5. Universities, museums and other institutions planning the sending of scientific expeditions to the tropics should be invited to cooperate with this institution in order to ob-

York in a search for the older sugar cane literature. The scanty representation of the literature from South American scientific institutions and experiment stations was quite surprising and there seemed to be a lamentable lack of effort to keep up with current publications from these sources.

[2] Attention is called to the report on Sugar Cane Mosaic or Yellow Stripe Disease recently published in *The Journal of the Department of Agriculture* of Porto Rico, Vol. 3, No. 4, as an example of the cooperative study of a serious tropical agricultural problem.

tain the greatest possible advantages from the expenditures and efforts made.

6. Each special problem would be organized independently, the permanent secretary assigning such workers to it as at the moment were most available. All expenses, including salaries of workers, would be met by the interested parties in each case, either industries or governments. The only expense to the National Research Council would thus be the maintenance of the permanent secretary and his office force engaged in the fundamentally important work of tabulating and correlating existing knowledge of tropical conditions and resources; and of keeping in close touch with all of the many scattered institutions and workers either official or otherwise who are now engaged in any of the lines embraced in this vast field of effort.

As time went on and funds were available the institution could also take up on its own account such lines of investigation as were not being covered by any other initiative.

An organization such as is thus briefly outlined would certainly give the maximum of elasticity and breadth of view with a minimum of fixed charges. It is respectfully submitted for the consideration of the National Research Council.

F. S. Earle

Rio Piedras, Porto Rico,
August 23

MILLS AND FISHWAYS

To the Editor of Science: Apropos of the article by Professor Henry B. Ward entitled "Atlantic and Pacific Salmon" in Science for September 17, 1920, allow me to record some observations. Some years ago I stocked a stream running through my country place in Connecticut with rainbow trout. These trout later ran down to the estuary and could not return because of two mill dams in the way. Discussing the matter with old inhabitants I learned that in former years before the dams were built farmers living along the stream for a distance of fifteen miles or more were in the habit of catching many barrels of alewives and salting them down for winter food supply. These families are now deprived of one important kind of food.

Following up this concrete object lesson I made observations along the Atlantic coast from Connecticut to Labrador. My conclusions are as follows:

Along the New England coast mills are commonly the property of local stockholders and these represent the influential men in a locality. Their first interest is in the mill and its economical management. This excludes the idea of the expense of a fishway. Fish which formerly supplied large numbers of people in the vicinity and at a distance and which naturally would supply the people for all time are prevented from ascending streams for breeding purposes. When the matter is taken up for action by a large number of indignant people they find themselves in conflict with a few influential men personally interested in the dam. This minority has the largest degree of influence with legislators. Along the entire New England coast such appears to be the situation in relation to salmon, shad, and alewives.

Upon reaching the Maritime Provinces of Canada I found a somewhat different situation. The traditions of an older civilization in regard to maintaining large food supply prevail to some extent. They come into conflict with the mill owner and his stockholders to such a degree that some of the streams remain open to anadromous fish, with the aid given by fishways.

Leaving the Maritime Provinces on the way northward I found a third order of conditions prevailing. The men who own cod traps and large nets are the men most influential with legislators. Constituting a small but potent minority they are enabled to injure food supply for the public by their manner of using cod traps and large nets. On some of the runways to salmon rivers the cod traps appear to pick up a large part of the annual run of salmon and the net fisherman at the mouths of the river deplete the fish supply by unlawful obstruction to the run of breeding fish.

My comments do not relate to hearsay but

to personal observation and inquiry extending from Connecticut to as far north as Hamilton Inlet in Labrador. The biology of the subject relates not so much to the habits of *Salmo salar* as it does to the behavior of *Homo sapiens*—with his specific appellation self-chosen.

Robert T. Morris
616 Madison Avenue, New York

EFFICIENCY IN THERMAL PHENOMENA

To the Editor of Science: Mr. Forbes's theory of something being wrong with the commonly accepted definitions of efficiency in thermal phenomena, is provocative of comment. The question of a definition being wrong depends, obviously, on how it is interpreted.

In general the efficiency of a machine or mechanical process, is defined as the ratio of output to input. It is assumed that the output will always be less than the input, hence the efficiency will be less than unity.

It is safe to say that the difficulties alluded to by Mr. Forbes can be traced to failure to distinguish between the quantities of energy called input and output, and the units in which they are measured. In the electric heater, the input, watts, is wholly converted into heat, with efficiency of 100 per cent. In the electric motor the input, watts, is converted into 95 per cent. work and five per cent. heat, giving 95 per cent. efficiency if work output is considered, and 100 per cent. efficiency for the entire output. In the steam engine the input, heat, is converted into ten per cent. work and 90 per cent. heat, giving an efficiency of ten per cent. based on work output, 90 per cent. efficiency based on the exhaust steam for heating, and 100 per cent. for the entire output. In the refrigerating machine the output is, logically, heat carried away by the condenser water. The input, on the same reasoning, is made up of two parts, the heat removed from the brine and the work of driving the machine. The sum of the two input quantities is equal to the output, giving 100 per cent. efficiency as in all the other cases.

The refrigerating engineer recognizes the difficulty of applying the term efficiency to his machine, and substitutes for it the term "coefficient of performance," the ratio of heat absorbed to the work required to drive the machine, both expressed in the same units.

If efficiency is defined by the input-output formula, it is true that the efficiency of all machines is 100 per cent. If only a portion of the input or output is considered, it is possible to have efficiencies of less or more than 100 per cent. In this case it would be appropriate to use the term "partial efficiency," since the entire output is not considered.

E. H. Lockwood

THE HELIUM ARC AS A GENERATOR OF HIGH FREQUENCY OSCILLATIONS

Helium as a conducting medium in a low-voltage arc may be of considerable utility as a convenient source for generating, from direct current, oscillations of moderately high frequency.

Due to its exceptionally low sparking potential arcs may be readily started from a hot tungsten cathode by 110 volts even when the gas is at atmospheric pressure. In fact it is easy to start the arc across a centimeter gap between cold electrodes by means of breaking a parallel circuit with a series reactance common to both. Perhaps a more convenient method of starting, however, is the heating of the filament by the source of supply and then a commutation of the connection to the positive terminal from the filament to the anode.

When the proper inductance and capacity are connected across the arc high frequency oscillations are produced which may be utilized in the usual way with a coupled circuit. Hitherto, hydrogen and compounds of hydrogen have been used in areas to produce high frequency and it is very difficult to produce oscillations by the use of other gases at atmospheric pressure. Helium, however, probably due to its high heat conductivity, being inferior only to hydrogen in this respect, from the rapid rate of energy dissipation in the arc, gives the type of volt ampere

characteristic which is necessary for the production of the alternating current.

From a 6-ampere arc in helium at approximately atmospheric pressure and with a centimeter gap, 50 watts or more of alternating current at 1,000 cycles may readily be obtained.

G. M. J. Mackay

Research Laboratory,
General Electric Co.,
Schenectady, N. Y.

SCIENTIFIC BOOKS

Collected Studies on the Pathology of War Gas Poisoning, from the Department of Bacteriology and Pathology, Medical Science Section, Chemical Warfare Service, under the direction of M. C. Winternitz, major, M. C., U. S. A. Yale University Press, New Haven, Conn. Cloth, 165 pages, 41 color plates, 83 black and white illustrations, $20.00.

The study of the pathological lesions produced by the war gases upon animals under controlled experimental conditions was of eminent practical importance during the war, and quite justly enlisted the interest and services of many of the foremost pathologists, both here and abroad. Without such control, it would have been difficult and, in many cases, impossible, to draw conclusions as to the comparative effectiveness of different types of gas used in offense; and to estimate the protection afforded by various defensive measures. Equally important was the desirability of defining, so far as this was possible, the effects of the various gases used by the enemy against our troops, and to afford criteria to the pathologists in the field by which they might be recognized.

The studies of Winternitz and his coworkers, which were available to the Chemical Warfare Service during the war, have now been made generally accessible in a comprehensive and beautifully illustrated monograph from the Yale University Press. On the basis of a very large experimental material, the gross and microscopic changes following exposure to chlorine, phosgene, chlorpicrin, trichloromethyl-chloroformate (diphosgene, superpalite), dichloroethylsulphide (mustard gas), cyanogen chloride and bromide, arsine, and several organic arsine-halogen compounds are minutely described. Unlike most of the reports which have previously appeared, the study includes a consideration of late residual lesions as well as the acuter changes, and this phase of the work will prove of particular interest to those who still are seeking an anatomical explanation for the chronic invalidism which afflicts so many of the soldiers gassed in the war. The writers find quite regularly in the lungs after recovery from phosgene, persistent emphysema and atelectasis, associated with obliterating bronchiolitis, and with tubercle-like peribronchial nodules. On the other hand, it is stated that "chronic changes in the lungs after mustard gas inhalation were infrequent and were confined to minute areas of organization occurring in isolated bronchioles or in the alveolar tissue near the margin of the lungs. In no case was any large bronchus found organized or occluded." In a few dogs, localized ulceration or cicatricial stenosis was found in the trachea. This rarity of permanent lesions after gassing with mustard in dogs does not accord with our own experience in the human cases. Without entering into details, it may be confidently stated that the inhalation of mustard gas in man is frequently followed by chronic changes in the entire respiratory tract. These differ, of course, in their extent and severity, but in many cases there results a destruction and deformity comparable to that of chronic pulmonary tuberculosis.

In this connection, it is perhaps proper to emphasize the limitations of these and similar experimental studies on the war gases, in their application to human pathology. Whereas the experimental worker with animals was informed as to the kind of gas used, its concentration and the duration of exposure, none of these data were available to the pathologist in the field. Frequently, it happened that the same soldier was exposed to several varieties of gas within a short period; frequently, also, there were complicating traumatic injuries. Most disturbing of all were the supervening

bacterial infections, and particularly the epidemic influenzal pneumonia which swept through our troops during the period when gas casualties were most numerous. Because of these complexities, many of the human cases presented a difficult problem for the pathologist, and it was not very easy for him to apply fully the knowledge gained from animal experimentation. For example, although blue cross shells containing diphenylchlorarsine were used in profusion against our troops in the later months of the war, and although animal experiments had shown this and related arsine compounds to possess a high degree of toxicity, not a single casualty amongst 576 recorded autopsies could be referred to organic arsine-halogen compounds alone, nor was it possible to differentiate the lesions from those of other vesicant and irritant gases in common use.

Such considerations should not detract from the value of the work. These studies, and the equally painstaking and complete experimental work of Warthin and Weller on Mustard Gas, are fundamental contributions to the pathology of the toxic gases used in the war.

Appended to the purely descriptive studies of gas lesions of various types, is an interesting chapter given to the subject of intratracheal therapy. It was found that dogs will tolerate intrapulmonary irrigation with physiological salt solution in amounts up to three liters, or more, when the fluid is introduced over a period of thirty minutes. Resorption from the lungs takes place very rapidly as could be shown by the elimination of phenolsulphonthalein in the urine; and no serious functional or anatomical disturbances are produced. This raises the question as to how far the œdema itself is responsible for the fatal outcome in cases of acute poisoning with the suffocant gases, and suggests that other factors, such as the increased viscosity of the blood, the obstruction to the pulmonary circulation, and the resultant cardiac weakness, may be of greater moment than the mere accumulation of fluid in the air spaces.

The demonstration that inert granular material and even bacteria can in great measure be washed out of the lungs, opens new possibilities of experimental research along therapeutic lines.

Alwin M. Pappenheimer
Columbia University

SPECIAL ARTICLES

THE TAKE-ALL DISEASE OF WHEAT IN NEW YORK STATE

For nearly two decades plant pathologists have been interested in the possible introduction of the take-all disease of wheat into America. A detailed historical and bibliographic treatment of this and some related diseases of wheat has recently been published by Stevens.[1] Conditions, believed to be due to take-all, have been reported from Oregon in 1902 and more recently (1919) from Illinois and from Virginia. However, the fungus *Ophiobolus graminis* Sacc. has not yet been reported from these localities in the papers which have come to the writers' notice. If the name of "take-all" be restricted to the disease with which *Ophiobolus graminis* is associated, there remains some doubt as to the reported occurrence of the true take-all in this country.

Early in July, 1920, the attention of Mr. R. G. Palmer, field assistant of the Department of Plant Pathology, was attracted to a small spot in a field of soft red winter wheat at East Rochester, New York. The plants within an area eight to ten feet in diameter were badly dwarfed and prematurely dead. In many cases secondary culms had been killed soon after their formation. On July 15 the diseased spot was brought to the attention of Dr. M. F. Barrus who brought specimens into the laboratory for examination. The roots of the plants were rotted and usually broken near the base of the culm when the plants were uprooted. The lower internodes were dark or entirely blackened and enveloped by a dense sheath-like plate of thick-walled brown mycelium. This plate of mycelium was formed between the leaf sheath and culm, as

[1] "Foot-rot Disease of Wheat—Historical and Bibliographic," Natural History Survey, Ill. Dept. Registration and Education, Vol. 13, Art. 9, 1919.

described by McAlpine[2] for *Ophiobolus graminis*. Perithicia in considerable abundance were found embedded in the leaf sheath and mycelial plate. Microscopic measurements of perithecia and ascospores agree very closely with those given by Saccardo for *Ophiobolus graminis*.

As soon as a determination of the fungus had been made steps were taken to determine the source of the infection and to completely eradicate the disease from the infected area. An inspection was made of the farm which had grown the seed for the past two years. No evidence of take-all was found on this farm or on any of a considerable number of others in the vicinity of the diseased field and elsewhere. The crop from an area forty feet in diameter was spread over the ground and gasoline was poured over the infected spot and vicinity. The whole was then burned over.

The writers are indebted to Dr. W. B. Brierly, of the Rothamsted Experiment Station, England, and Professor Et. Foëx, of the Station de Pathologie Végétale, Paris, France, for examination of the affected wheat. Dr. Brierly states that the disease is indistinguishable from the take-all as it occurs in England. Professor Foëx concludes that the associated fungus is undoubtedly a species of *Ophiobolus*. Saccardo lists two species of *Ophiobolus* as occurring on wheat, *O. graminis* Sacc. and *O. herpotrichus* (Fr) Sacc. The ascospores of *O. herpotrichus* measure 135–150 × 2–2.5 microns, practically double the spore length of *O. graminis*. It has already been pointed out that the fungus under consideration agrees closely in spore measurements with Saccardo's *O. graminis*. It is not intended here to settle the question of the pathogenicity of the *Ophiobolus* as it occurs in this country or abroad. However, both the fungus and the diseased symptoms with which it is associated agree in essential details with the take-all of wheat and *Ophiobolus graminis* as described in Australia, France and elsewhere.

R. S. Kirby,
H. E. Thomas

Cornell University

[2] McAlpine, D., "Take-all and White Heads in Wheat," Victoria Dept. Agr. Bul, 9, 1904.

THE AMERICAN CHEMICAL SOCIETY. XII

Division of Pharmaceutical Chemistry

Charles E. Caspari, *chairman*

Edgar B. Carter, *secretary*

Stability and chloramine antiseptics: Jules Bebie.

Chemistry and pharmacology of the chloramines: Carl Nielsen.

Colorimetric estimation of adrenalin: Wilbur L. Scoville.

Improved methods for arsenic estimation: H. F. Farr.

The melting point and the determination of free salicylic acid in acetyl salicylic acid: L. A. Watt.

Biological methods for digitalis assay: Herbert C. Hamilton.

Researches on hypnotics: E. H. Volwiler.

Researches on anesthetics: Roger Adams.

Wood alcohol and prohibition: Chas. Baskerville.

Drug absorption in the intestinal tract: G. H. A. Clowes and A. L. Walters.

Iodine tolerance of the human body and iodine therapy: H. C. P. Weber. A very unusual case of cure of tubercular meningitis is discussed. Only isolated instances of recovery from this disease are known in the literature. The cure was effected by dosage with extraordinary quantities of iodine, given as tincture with various albuminoses and fatty vehicles of administration. The maximum was 1 gram of iodine per day (equivalent to 0.033 g. per kg. body weight); the total equaled 12.35 g. over 22 consecutive days. No iodism was noted. The conclusions drawn were that (*a*) the maximum dose of I is not known, (*b*) the disturbing effects, iodism, are astonishingly small, or even absent, (c) therapeutic effects as bactericide, require piling up of I in the body, (*d*) that the disturbing effects of KI are often confused with the effects of I itself, (*e*) that aside from this, the methods of administering the I are of less significance. These conclusions seem to be worthy of, and require, verification.

The pharmaceutical chemistry and pharmacology of the chloramines: Carl Nielsen. To obtain best results with the chloramines some knowledge of the chemistry of these products, particularly as regards incompatibilities, combinations and pharmacologic action, is essential.

Research on hypnotics: E. H. Volwiler. History of hypnotics, soporifices, and sedatives.

Present day hypnotics, with comparative value and uses. Qualities desired in hypnotics and present research in this field.

Research on anesthetics: ROGER ADAMS. Former anesthetics and their uses and drawbacks. Transition from natural to improved synthetic products. Qualifications of a good anesthetic and how the problem is being solved.

Improvements in the methods for arsenic estimation: H. V. FARR. A very brief review of the methods in present use is given. In addition to this a variation in the Gutzeit method is outlined, whereby the preliminary preparation of the chemical in ordinary cases is eliminated. Sulphites, etc., are oxidized by bromine and the arsenic subsequently reduced by potassium iodide, both of these reactions being accomplished within the reaction cell while the test is going on, representing a very great saving of time. In addition to this some simple methods for removing metals which interfere with the Gutzeit test are outlined, thus rendering this method more widely applicable. A gravimetric method for determining arsenic in the metallic form where this metal is present in considerable amounts is outlined. This is particularly applicable in cases where the simpler volumetric methods can not be used.

The colorimetric estimation of adrenalin: WILBUR L. SCOVILLE. Solutions of adrenalin are necessarily acid, if kept in stock, in order to preserve the activity. This acid has a marked effect upon the color produced. The official process is designed for the estimation of adrenalin in the dried glands, and will apply to these, but is not satisfactory for commercial solutions. A method is given which is applicable to both, and which the author considers preferable to the official process. It is based upon Krauss's method, using potassium iodate as the oxidizing agent and pure adrenalin as a standard.

Stability of chloramine antiseptics: JULES BEBIE. In order to assure the greatest possible degree of stability the chloramines must be produced with a high degree of purity. Investigation extended over period of one year indicates that chloramine-T in crystal and tablet form, by itself or when mixed with $NaHCO_3$ is stable. Aqueous solutions of chloramine-T alone or in mixture with Na_2CO_3 or NaCl are also stable. Dichloramine-T in powder form begins to deteriorate after about three months. The crystallized commercial product, however, is stable for about 8 months, and after 14 months shows only very slight degree of decomposition. Solutions of crystallized dichloramine-T in chlorosane are fairly stable for a couple of weeks. Halazone is fairly stable. Decomposition after one year amounts to about 3 per cent.

The determination of the melting point and free salicylic acid content of acetylsalicylic acid: L. A. WATT. A comparison of the methods in general use for the determination of the melting point of acetylsalicylic acid. The desirability of a uniform procedure is emphasized by the variation in the results obtained. For estimating the free salicylic acid content, comparison with a set of standards made from a mixed dye solution permits the close approximation of the violet color produced by the addition of ferric chloride to the acteylsalicylic acid solution.

The biologic methods for digitalis assay: HERBERT C. HAMILTON. The author questions the relevancy of certain criticisms of biologic assay on the ground that such an assay is limited in its scope. Biologic assays are not to decide the question of dosage nor the applicability of the drug for any particular purpose nor does a biologic assay merely record that a drug will kill an animal and permit the inference that the drug is standardized. A biologic assay is a comparison of the sample in question with a similar preparation of known activity. The comparison of effects is made on some test animal which responds to the action of the drug in so characteristic a manner that the effect is measurable. The proposed methods for digitalis with their advantages and disadvantages are described at length in order to emphasize the scope and limitations of the biologic assay of the digitalis series.

CHARLES L. PARSONS,
Secretary

(To be continued)

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.
NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, OCTOBER 22, 1920

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

INSTITUTES OF ANTHROPOLOGY[1]

THE anthropological problems of the present day are so numerous and so pressing that we can afford to select those of the greatest utility. Indeed, the three university institutes of anthropology I have suggested would have to specialize and then work hard to keep abreast of the problems which will crowd upon them. One might take the European races, another Asia and the Pacific, and a third Africa. America in anthropology can well look after itself. In each case we need something on the scale of the Paris Ecole d'Anthropologie, with its seventeen professors and teachers, with its museums and journals. But we want something else—a new conception of the range of problems to be dealt with and a new technique. From such schools would pass out men with academic training fit to become officials, diplomatic agents, teachers, missionaries, and traders in Europe, in Asia or in Africa, men with intelligent appreciation of and sympathy with the races among whom they proposed to work.

But this extra-state work, important as it is, is hardly comparable in magnitude with the intra-state work which lies ready to hand for the anthropological laboratory that has the will, the staff and the equipment to take it up efficiently. In the present condition of affairs it is only too likely that much of this work, being psychometric, will fall into the hands of the psychologist, whereas it is essentially the fitting work of the anthropologist, who should come to the task, if fitly trained, with a knowledge of comparative material and of the past history, mental and physical, of mankind, on which his present faculties so largely depend. The danger has

[1] Concluding part of the address of the president of the Anthropological Section of the British Association for the Advancement of Science, Cardiff, 1920.

arisen because the anthropometer has forgotten that it is as much his duty to measure the human mind as it is his duty to measure the human body, and that it is as much his duty to measure the functional activities of the human body—its dynamical characters—as its statical characters. By dynamical characters I understand such qualities as resistance to fatigue, facility in physical and mental tasks, immunity to disease, excitability under stimuli, and many kindred properties. If you tell men that we are here trenching on the field of psychology and medicine, I reply: Certainly; you do not suppose that any form of investigation which deals with man—body or mind—is to be omitted from the science of man? If you do you have failed to grasp why anthropology is the queen of the sciences. The university anthropological institute of the future will have attached to it a psychologist, a medical officer and a biologist. They are essential portions of its requisite staff, but this is a very different matter from lopping off large and important branches of its fitting studies, to lie neglected on the ground, or to be dragged away, as dead wood, to be hewn and shapen for other purposes by scientific colleagues in other institutes. Remember that I am emphasizing that side of anthropology which studies man in the service of the state—anthropology as a utile science—and that this is the only ground on which anthropology can appeal for support and sympathy from state, from municipality, and from private donors. You will notice that I lay stress on the association of the anthropological institute with the university, and the reasons for this are manifold. In the first place, every science is stimulated by contact with the workers in allied sciences; in the second place, the institute must be a teaching as well as a researching body, and it can only do this effectively in association with an academic center—a center from which to draw its students and to recruit its staff. In the third place, a great university provides a wide field for anthropometric studies in its students and its staff. And the advantages are mutual. It is not of much service to hand a student a card containing his stature, his weight, his eye color, and his head length! Most of these he can find out for himself! But it is of importance to him to know something of how his eye, heart, and respiration function; it is of importance to him to know the general character of his mental qualities, and how they are associated with the rapidity and steadiness of muscular responses. Knowledge on these points may lead him to a fit choice of a career, or at any rate save him from a thoroughly bad choice.

In the course of my life I have often received inquiries from schoolmasters of the following kind: We are setting up a school anthropometric laboratory, and we propose to measure stature, weight, height sitting, etc. Can you you suggest anything else we should measure?

My invariable reply is: Don't start measuring anything at all until you have settled the problems you wish to answer, and then just measure the characters in an adequate number of your boys, which will enable you to solve those problems. Use your school as a laboratory, not as a weighhouse.

And I might add, if I were not in dread of giving offence: And most certainly do not measure anything at all if you have *no* problem to solve, for unless you have you can not have the true spirit of the anthropologist, and you will merely increase that material up and down in the schools of the country which nobody is turning to any real use.

Which of us, who is a parent, has not felt the grave responsibility of advising a child on the choice of a profession? We have before us, perhaps, a few meager examination results, an indefinite knowledge of the self-chosen occupations of the child, and perhaps some regard to the past experience of the family or clan. Possibly we say John is good with his hands and does not care for lessons; therefore he should be an engineer. That may be a correct judgment if we understand by engineer, the engine-driver or mechanic. It is not true if we think of the builders of Forth Bridges and Assuan Dams. Such men

work with the head and not the hand. One of the functions of the anthropological laboratory of a great university, one of the functions of a school anthropometric laboratory, should be to measure those physical and mental characters and their inter-relations upon which a man's success in a given career so much depends. Its function should be to guide youth in the choice of a calling, and in the case of a school to enable the headmaster to know something of the real nature of individual boys, so that that much-tried man does not feel compelled to hide his ignorance by cabalistic utterances when parents question him on what their son is fitted for.

Wide, however, as is the anthropometric material in our universities and public schools, it touches only a section of the population. The modern anthropologist has to go further; he has to enter the doors of the primary schools; he has to study the general population in all its castes, its craftsmen, and its sedentary workers. Anthropology has to be useful to commerce and to the state, not only in association with foreign races, but still more in the selection of the right men and women for the staff of factory, mine, office and transport. The selection of workmen to-day by what is too often a rough trial and discharge method is one of the wasteful factors of production. Few employers even ask what trades parents and grandparents have followed, nor consider the relation of a man's physique and mentality to his proposed employment. I admit that progress in this direction will be slow, but if the work undertaken in this sense by the anthropologist be well devised, accurate, and comprehensive, the anthropometric laboratory will gradually obtain an assured position in commercial appreciation. As a beginning, the anthropologist by an attractive museum, by popular lectures and demonstrations, should endeavor to create, as Sir Francis Galton did at South Kensington, an anthropometric laboratory frequented by the general population, as well as by the academic class. Thus he will obtain a wider range of material. But the anthropologist, if he is to advance his science and emphasize its services to the state, must pass beyond the university, the school, and the factory. He must study what makes for wastage in our present loosely organized society; he must investigate the material provided by reformatory, prison, asylums for the insane and mentally defective; he must carry his researches into the inebriate home, the sanatorium, and the hospital, side by side with his medical collaborator. Here is endless work for the immediate future, and work in which we are already leagues behind our American colleagues. For them the psychometric and authropometric laboratory attached to asylum, prison, and reformatory is no startling innovation, to be spoken of with bated breath. It is a recognized institution of the United States to-day, and from such laboratories the "fieldworkers" pass out, finding out and reporting on the share parentage and environment have had in the production of the abnormal and the diseased, of the anti-social of all kinds. Some of this work is excellent, some indifferent, some perhaps worthless, but this will always be the case in the expansion of new branches of applied science. The training of the workers must be largely of an experimental character, the technique has to be devised as the work develops. Instructors and directors have to be appointed, who have not been trained *ad hoc*. But this is remedying itself, and if indeed, when we start, we also do not at first limp somewhat lamely along these very paths, it will only be because we have the advantage of American experience.

There is little wonder that in America anthropology is no longer the stepchild of the state. It has demanded its heritage, and shown that it can use it for the public good.

If I have returned to my first insistence that the problems handled by the anthropologist shall be those useful to the state, it is because I have not seen that point insisted upon in this country, and it is because my first insistence, like my third, involves the second for its effectiveness—the establishment in our chief universities of anthropological institutes. As Gustav Schwalbe said of an-

thropology in 1907—and he was a man who thought before he spoke, and whose death during the war is a loss to anthropologists the whole world over—"a lasting improvement can only arise if the state recognizes that anthropology is a science preeminently of value to the state, a science which not only deserves but can demand that chairs shall be officially established for it in every university. . . . Only this spread of officially authorized anthropology in all German universities can enable it to fulfil its task, that of training men who, well armed with the weapon of anthropological knowledge, will be able to place their skill at the service of the state, which will ever have need of them in increasing numbers."[2]

Our universities are not, as in Germany, government-controlled institutions, although such control is yearly increasing. Here we have first to show that we are supporting the state before the state somewhat grudgingly will give its support to us. Hence the immediate aim of the anthropologist should be —not to suggest that the state should *a priori* assist work not yet undertaken, but to do what he can with the limited resources in his power, and when he has shown that what he has achieved is, notwithstanding his limitations, of value to the state, then he is in a position to claim effective support for his science.

I have left myself little time to place fairly before you my third insistence.

ADOPTION OF A NEW TECHNIQUE

What is it that a young man seeks when he enters the university—if we put aside for a moment any social advantages, such as the formation of lifelong friendships associated therewith? He seeks, or ought to seek, training for the mind. He seeks, or ought to seek, an open doorway to a calling which will be of use to himself, and wherein he will take his part, a useful part, in the social organization of which he finds himself a member. Much as we may all desire it, in the pressure of modern life, it is very difficult for the young man of moderate means to look upon the university training as something apart from his professional training. Men more and more select their academic studies with a view to their professional value. We can no longer combine this senior wranglership with the pursuit of a judgeship; we can not pass out in the classical tripos and aim at settling down in life as a Harley Street consultant; we can not take a D.Sc. in chemistry as a preliminary to a journalistic career. It is the faculties which provide professional training that are crowded, and men study nowadays physics or chemistry because they wish to be physicists or chemists, or seek by their knowledge of these sciences to reach commercial posts. Even the very faculty of arts runs the danger of becoming a professional school for elementary school teachers. I do not approve this state of affairs; I would merely note its existence. But granted it, what does anthropology offer to the young man who for a moment considers it as a possible academic study? There are no professional posts at present open to him, and few academic posts.[3] There is little to attract the young man to anthropology as a career. Is its position as a training of mind any stronger? The student knows if he studies physics or chemistry or engineering that he will obtain a knowledge of the principles of observation, of measurement, and of the interpretation of data, which will serve him in good stead whenever he has to deal with phenomena of any kind. But, alas! in anthropology, while he finds many things of surpassing interest, he discovers no generally accepted methods of attacking new problems, *quot homines, tot sententiæ*. The type of man we want in anthropology is precisely the man who now turns to mathematics, to physics and to astronomy—the man with an exact

[2] *Correspondenz Blatt*, Jahrg. XXXVIII., S. 68.

[3] In London, for example, there is a reader in physical anthropology who is a teacher in anatomy, and a professorship in ethnology, which for some mysterious reason is included in the faculty of economics and is, I believe, not a full-time appointment.

mind who will not take statements on authority and who believes in testing all things. To such a man anthropometry—in all its branches, craniometry, psychometry and the wide field in which body and mind are tested together under dynamic conditions—forms a splendid training, *provided* his data and observations are treated as seriously as those of the physicist or astronomer by adequate mathematical analysis. Such a type of man is at once repelled from our science if he finds in its text-books and journals nothing but what has been fitly termed "kindergarten arithmetic." Why the other day I saw a paper by a distinguished anthropologist an attempt to analyze how many individual bones he ought to measure. He adopted the simple process of comparing the results he obtained when he took 10, 20, 30 individuals. He was not really wiser at the end of his analysis than at the beginning, though he thought he was. And this, notwithstanding that the whole matter had been thrashed out scientifically by John Bernoulli two centuries ago, and that its soluton is a commonplace of physicist and astronomer!

How can we expect the scientific world to take us seriously and to treat anthropology as the equal of other sciences while this state of affairs is possible? What discipline in logical exactness are we offering to academic youth which will compare with that of the older sciences? What claim have we to advise the state until we have introduced a sounder technique and ceased to believe that anthropometry is a science that any man can follow, with or without training? As I have hinted, the problems of anthropology seem to me as subtle as those of physical astronomy, and we are not going to solve them with rusty weapons, nor solve them at all unless we can persuade the "brainy boys" of our universities that they are worthy of keen minds. Hence it seems to me that the most fertile training for academic purposes in anthropology is that which starts from anthropometry in its broadest sense, which begins to differentiate caste and class and race, bodily and mental health and disease, by measurement and by the analysis of measurement. Once this sound grounding has been reached the trained mind may advance to ethnology and sociology, to prehistory and the evolution of man. And I shall be surprised if equal accuracy of statement and equal logic of deduction be not then demanded in these fields, and I am more than half convinced, nay, I am certain, that the technique the student will apply in anthropometry can be equally well applied in the wider fields into which he will advance in his later studies. Give anthropology a technique as accurate as that of physics, and it will forge ahead as physics has done, and then anthropologists will take their due place in the world of science and in the service of the state.

Francis Galton has a claim upon the attention of anthropologists which I have not. He has been president of your institute, and he spoke just thirty-five years ago from the chair I now occupy, pressing on you for the first time the claims of new anthropological methods. In Galton's words: "Until the phenomena of any branch of knowledge have been submitted to measurement and number it can not assume the status and dignity of a science." Have we not rather forgotten those warning words, and do they not to some extent explain why our universities and learned societies, why the state and statesmen, have turned the cold shoulder on anthropology?

This condition of affairs must not continue; it is good neither for anthropology, nor for the universities, nor for the state if this fundamental science, the science of man, remains in neglect. It will not continue if anthropologists pull together and insist that their problems shall not fail in utility, that their scientific technique shall be up to date, and that anthropological training shall be a reality in our universities—that these shall be fully equipped with museums, with material, with teachers and students.

It is almost as difficult to reform a science as it is to reform a religion; in both cases the would-be-reformer will offend the sacrosanct upholders of tradition, who find it hard to discard the faith in which they have been reared.

But it seems to me that the difficulties of our time plead loudly for a broadening of the purpose and a shapening of the weapons of anthropology. If we elect to stand where we have done a new science will respond to the needs of state and society; it will spring from medicine and psychology, it will be the poorer in that it knows little of man's development, little of his history or pre-history. But it will devote itself to the urgent problems of the day. The future lies with the nation that most truly plans for the future, that studies most accurately the factors which will improve the racial qualities of future generations either physically or mentally. Is anthropology to lie outside this essential function of the science of man? If I understand the recent manifesto of the German anthropologists, they are determined it shall not be so. The war is at an end, but the critical time will be with us again, I sadly fear, in twenty to thirty years. How will the states of Europe stand then? It depends to no little extent on how each of them may have cultivated the science of man and applied its teaching to the improvement of national physique and mentality. Let us take care that our nation is not the last in this legitimate rivalry. The organization of existing human society with a view to its future welfare is the crowning task of the science of man; it needs the keenest-minded investigators, the most stringent technique, and the utmost sympathy from all classes of society itself. Have we, as anthropologists, the courage to face this greatest of all tasks in the light of our knowledge of the past and with our understanding of the folk of to-day? Or shall we assert that anthropology is after all only a small part of the science of man, and retreat to our study of bones and potsherds on the ground that science is to be studied for its own sake and not for the sake of mankind? I do not know what answer you will give to that question, yet I am convinced what the judgment of the future on your answer is certain to be.

KARL PEARSON

SULPHUR AS A FERTILIZER

INFORMATION concerning the relation of sulphur to plant nutrition and growth has been accumulating during the last decade, and the mass of data has now become so important that it demands recognition of all investigators of nutritional problems. Indeed, it seems to me that much of our past experimental field work dealing with the influence of fertilizer elements upon plants has been so loosely done that we are under the necessity of reexamining the whole matter.

Although the value of sulphur, particularly in the form of gypsum, was recognized at an early period in our national history, the lack of uniform success with it soon led to its neglect as an important fertilizer. And after the invention of acid phosphate about the middle of the last century, the development was almost wholly toward soluble fertilizers containing nitrogen, phosphorus, and potassium. Sulphur was not included as a part of a complete fertilizer, although it was recognized as necessary to plant growth. The soil was thought to contain enough sulphur, and plants to need so little of it, that it was added to the soil only incidentally, as in acid phosphate, potassium sulphate, or ammonium sulphate, along with the three elements forming the so-called "complete" fertilizer.

Experiment station workers and other students of mineral nutrition of plants fell into loose ways of working with fertilizer salts. They have not hesitated to use sulphur-containing nitrogenous compounds when testing the influence of increased nitrogen on plant growth. Similarly the acid phosphate has been used in testing the effects of phosphorus; and potassium sulphate has been used when potassium was under observation. In comparing various forms of fertilizer elements we find the superphosphate for instance pitted against bone meal; or potassium sulphate against potassium chloride; or ammonium sulphate against sodium nitrate as a source of nitrogen. It is evident that such tests as these are all invalid if sulphur itself is shown to be an important fertilizer element. For the ex-

periments have at least two variables, and it would be impossible to ascribe differences in growth to one element with any certainty that the other element was not partly responsible for the result. The recent facts brought out in regard to sulphur should lead at once to a widespread reexamination of these problems, with more rigidly designed and controlled experimentation.

The basic facts brought out are briefly summarized here. In the first place, soil studies have shown that sulphur is one of the rare necessary elements. Soils are generally no richer in sulphur than in the fertilizer elements, nitrogen, phosphorus and potassium. This scarcity of sulphur in normal soils is probably related to the ready leaching of sulphur into drainage water. At the same time improved analytical methods have demonstrated that crop plants require more sulphur than was formerly supposed. They remove it from the soil fully as rapidly as they remove any of the other elements which may become limiting factors. The normal sulphur content of soils is sufficient for from fifteen to seventy crops, provided there are no additions from outside sources, as from rainfall. Even if we count in the rainfall sulphur, it is probable that sulphur is just as often a limiting factor as is phosphorus, or nitrogen, or potassium. For two of the last named elements do not leach as readily as sulphur. The important point is this: If sulphur *is* a limiting factor, addition of any other fertilizer is useless, and a waste, just as much as would be the use of gypsum as a fertilizer if phosphorus were the limiting factor.

Instead of thinking of the N. P. K. formula as representing a "complete" fertilizer it is time we began work solely from the standpoint of limiting factors, including not only these three, but S, Ca, Mg, and any other factors which influence crop production. The early failures with gypsum were probably due to the fact that phosphorus or some other element besides sulphur was limiting growth, or that sulphur at any rate was not the thing needed. These remarks must not be construed as argument for the discontinuance of any of the fertilizer elements now in common use. It would be a grave error to try to replace them with sulphur when they are deficient, but we can no longer ignore sulphur as one of the very important fertilizer elements.

Since the Cruciferæ and Leguminosæ are known to use quantities of sulphur in their metabolism, crop plants of these families must be the ones most likely to suffer from deficiency of sulphur. Recent work by Reimer[1] at the Oregon Agricultural Experiment Station is very significant and deserves the attention of agriculturists and scientists all over the country. He has found that many of the soils of Oregon are deficient in sulphur, and that addition of sulphur-containing compounds of almost any kind may lead to very remarkable increases in the yield of alfalfa or clovers upon such soils. His experiments extended over several years, and involved a variety of soils. The increased production ran from 50 to 1,000 per cent. in alfalfa, with application of such sulphur-containing materials as gypsum, superphosphate, flowers of sulphur, etc. Addition of phosphorus without sulphur had practically no effect, showing that the acid phosphate was valuable only for its sulphur content in this case. The possibility of such increases is a challenge to agriculturists everywhere in these times of under production.

The best results seem to come when the sulphur is used as a top dressing on the legume crop. The usual custom in the United States is to fertilize the cereals, wheat, etc., and allow the legumes to get the effects a year or two later. Sulphur applied in this way does the legume crop little good, for most of it disappears out of the soil by leaching before the legume comes in the rotation. The early successes were most notable when application of the sulphur fertilizer was made directly to the crops most needing it, the legumes. These convert the sulphur into the organic form, and if used as green or stable manures provide sulphur for succeeding crops in a non-leaching form. It seems quite clear that we

[1] Reimer, F. C., "Sulphur as a Fertilizer for Alfalfa in Southern Oregon," Oregon Agr. Coll. Exp. Sta. Bull. 163, 1919.

are applying our sulphur fertilizers at the wrong place in the rotation when we use them with the cereal grains which require little sulphur. Top dressing in legumes would be the logical time in the rotation to provide the sulphur when it is known to be deficient in amount.

While the results obtained by Reimer are certain not to be duplicated on certain types of soils in the eastern United States, as for instance on soils deficient in lime, or on acid soils, the results indicate that it is worth while to test out the value of sulphur generally through the country. The fact that the early users of gypsum over a century ago had similar results with soils in Pennsylvania and Virginia should encourage renewed experimentation with sulphur fertilizers, under conditions that preclude confusing one limiting factor with another. As already suggested, the early failures were probably caused by the soils being deficient in phosphorus rather than sulphur in some cases, or deficient in both at once, or at any rate not in sulphur alone.

We know enough now to make our tests crucial as to which element or elements limit production. The only way we can know the facts will be by actual tests. The system of soil fertility upon which our vast expenditure for fertilizers is based should be examined and tested with open unprejudiced minds. The tests of sulphur containing fertilizers should be made over wide areas in the eastern United States, for there must be many soils in which sulphur is deficient for optimum nutrition of high sulphur-requiring plants. In many cases where superphosphate has been used with success, it may be the sulphur, rather than the phosphorus that is the valuable element. In such cases substitution of the cheaper gypsum might yield as satisfactory results as the more expensive fertilizer.

American agriculture would be vastly benefitted by extensive experimentation along the lines suggested, with strictly controlled conditions under which alone can we have a proper interpretation of results. With our expenditure for fertilizers much in excess of a hundred million dollars annually, it is highly important that our fertilizer practise should be put upon a rational basis at the earliest possible moment.

CHARLES A. SHULL
UNIVERSITY OF KENTUCKY,
LEXINGTON, KY.

ERIC DOOLITTLE

ERIC DOOLITTLE, Flower professor of astronomy and director of the Flower Astronomical Observatory died September 21, 1920. In 1917 he was called upon to organize and conduct the U. S. Shipping Board Navigation School at Philadelphia. In attempting to teach the large number of men suddenly thrust upon him and to attend to the correspondence, registration and other necessary details without assistance, none being provided or immediately available, he greatly overtaxed his strength and collapsed under a slight stroke. Although later he was able to resume his university duties, he never fully recovered and did but little observing thereafter. In May, 1920, he became ill again. When his condition became serious he was removed to the University Hospital on June 24, at which place he died.

Professor Doolittle was born in Indiana in 1870. In 1876 his father, C. L. Doolittle, became professor of mathematics and astronomy at Lehigh University. The son graduated there as a civil engineer. After practising this profession for a year he was instructor in mathematics at Lehigh for a year and at the University of Iowa for two years. After spending a year in graduate work in astronomy at the University of Chicago, he became instructor in astronomy at the University of Pennsylvania in 1896, where his father has been called in the meantime as professor of astronomy.

The Flower Observatory was established in 1896. Eric Doolittle was placed in charge of the new 18-inch refractor with its superb Brashear lens. The telescope was made with a long focus, 30 feet, for double star observation. He immediately began his observations of double stars. He used the telescope almost

always when the stars were visible early or late. By day he had classes to meet in class rooms five miles away. For one evening each week the telescope was devoted to visitors. During cloudy weather, between classes and at other odd times he was busy in applying the new method developed by G. W. Hill, for the computation of the secular perturbations of the planets. No constitution could stand this terrific pace. His premature death was the result.

Professor Doolittle's fame rests chiefly upon his observations and discussions of double stars. The publications of the Flower Observatory contain measures of 3,920 double and multiple stars made by him together with the remeasurement of 648 double stars discovered by Hough. Another series of observations is ready for publication. Many discussions of double stars and other subjects are found in the astronomical journals.

In 1913 S. W. Burnham, who had long been recognized as the world's authority upon double stars, feeling that his age no longer permitted him to attend properly to the duties he formerly performed turned over his manuscripts and his library on double stars, a practically complete and priceless collection, to Professor Doolittle, thus placing the mantle of the world's foremost double star astronomer upon him. Burnham's great work "General Catalogue of Double Stars" appeared in 1906. Professor Doolittle has been most faithful to his trust, for in the safe at the Flower Observatory there is a large card catalogue known as the extension of Burnham's General Catalogue. On these cards are found the observations, discoveries and other information relating to double stars which has accumulated since the publication of the General Catalogue. This information is available to those interested. The work will of course go on and be published at some future time.

The results of his computations of secular perturbations were published as the parts were completed in *The Astronomical Journal.* When all the work was done the results were combined and discussed in "The Secular Perturbations of the four Inner Planets" published by the American Philosophical Society, of which he was a member, in 1912. These results were obtained with most painstaking care and are not likely to be superseded for a long time.

He helped to popularize astronomy by editing and himself writing a large part of Vol. IV. of the "Foundation Library" entitled "The Wonderful Universe" and another work which has not yet appeared. He was widely known as the author of a series of popular monthly articles on current astronomical events which have appeared in various magazines and newspapers throughout the country continuously from 1904 until August, 1920.

He was extremely modest, loving simplicity and hating ostentation. His great ability and worth would no doubt have been more widely known and appreciated had he been more of a selfseeker. He was greatly admired and loved by his students, particularly by graduate students. Those who knew him best loved him most.

Samuel G. Barton

SCIENTIFIC EVENTS

AGRICULTURAL WORK OF THE NATIONAL RESEARCH COUNCIL

With the advice and assistance of the National Research Council a cooperating group of scientific investigators of insect pests and plant diseases together with representatives of leading industrial concerns engaged in the manufacture of chemicals and appliances used in fighting these enemies of crops has been organized under the name of the Crop Protection Institute. This institute will undertake and support a series of thorough scientific studies of the crop pests themselves and of the means of improving and standardizing the materials and appliances used in fighting them. The Board of Trustees of the institute is composed of nine scientific men representing leading scientific organizations interested in crop protection and four representatives of the manufacturing and commercial interests. The temporary secretary is Mr. Harrison E. Howe, chairman of the Division of Research Extension of the National Research Council.

The annual losses because of the attacks on growing and stored crops by insect pests and plant diseases are enormous despite all that has been done to lessen them. A conservative estimate of the loss of wheat in the United States in a single recent year because of the black stem rust is 180,000,000 bushels, and this pest is but one of the many that attack the wheat every year. What is needed is a combination and concentration of attack on these pests. The new Crop Protection Institute will help to bring this about. It is not intended that the institute will interfere with or duplicate existing efforts now being made by government bureaus, state experiment stations and other agencies to fight crop pests, but that it will introduce a more general cooperation in the work and give special attention to filling important gaps that now exist in it.

The National Research Council has issued a list of references to investigations upon the production of corn and its uses, prepared by M. Helen Keith, of the Illinois Agricultural Experiment Station. The list includes over 1,300 articles which have been published within recent years in this country and abroad. These investigations cover a wide range of problems such as the breeding and growing of corn as affecting its yield and nutritive qualities, the curing of corn and the preparation of silage, the systematic feeding of farm animals, the physiology of corn nutrition, including its relation to pellagra, the chemical composition of corn, and the extraction of such products as iodine, chloroform, oils, alcohol and benzine. Altogether the list shows that the scientific investigation of all phases of corn problems has become exceedingly extended and important.

THE PROPOSED EXPEDITION TO ASIA OF THE AMERICAN MUSEUM OF NATURAL HISTORY

ANNOUNCEMENT has been made of an expedition to be sent out by The American Museum of Natural History in cooperation with the American Asiatic Association and *Asia Magazine*, the object of which is to search for the most primitive human remains. It will work for five years in various remote regions of central Asia and will be under the direction and leadership of Mr. Roy Chapman Andrews, associate curator of mammals in The American Museum of Natural History, who for the last ten years has been carrying on zoological explorations in various parts of the Far East. The expedition will be financed by a fund of $250,000, which is being provided by The American Museum of Natural History, The American Asiatic Association and *Asia Magazine*, and the private subscriptions of Mrs. Willard Straight, Messrs. J. P. Morgan, George F. Baker, Childs Frick, W. A. Harriman and Mr. and Mrs. Charles L. Bernheimer.

In the year 1891, a Dutch army surgeon, Eugene Dubois, while excavating for fossils in central Java, discovered near Trinil part of a skull, two molar teeth and a thigh bone. This discovery has been supplemented by that of other indisputably human remains of which the most ancient, found in southern Germany, is the jaw of the so-called Heidelberg man who may be two hundred and fifty thousand years old.

With the exception of the Java specimen, all fossil human fragments have been discovered in Europe or England. It is, however, believed, that whatever light may be thrown upon the origin of man will come from the great Asian plateau.

Leaving about the first of next February, headquarters for the expedition will be established in Peking. The first year will be devoted to studies in paleontology and zoology in China; the second year the work will be carried into Mongolia and a geologist will be added to the field staff; the third, fourth and fifth years archeologists and anthropologists will be sent out who with the zoologists and paleontologists will carry on work in various parts of Asia.

The importance of this region long has been recognized, but no systematic study on a large scale ever has been attempted, and there is no similar area of the inhabited surface of the earth about which so little is known. Whether or not human remains are found it

will yield rich collections in all branches of science.

The material will be exhibited in the proposed Hall of Asiatic Life in The American Museum of Natural History, which it is hoped the city will add to the museum buildings in the near future, and it is hoped that this expedition will make New York the center of Asiatic scientific activity.

The scientific results of the Third Asiatic Expedition will be embodied in a series of volumes that should be, for many years to come, the standard work on the natural history of Central and Eastern Asia, and also in popular books written in non-technical language. Furthermore, the public will be regularly informed of the whereabouts and the activities of the members of the expedition, for articles written in the field will be published in *Asia Magazine*.

Those responsible for the expedition desire to make it a factor in the development of the educational life of the Chinese Republic. China has no institution wherein natural history objects can be studied and exhibited by modern methods and where the scientific work of her own people can be encouraged and directed. It has therefore been decided to invite the Chinese government to cooperate with the expedition in carrying on its work in the Orient. China will be invited to delegate to the expedition certain men who have had already preliminary instruction in various branches of science; under specialists these men, while in the field, will receive training in modern methods of scientific exploration and study.

When the expedition has been completed, it has been agreed to deposit in Peking a duplicate set of the collections, which will form the basis of the Chinese Museum of Natural History. The proposed institution will then have a valuable nucleus of specimens for exhibition and study and a staff of expert Chinese to carry on the work. It will remain for the government to set aside a suitable building where the collections can be housed.

THE THOMAS A. EDISON PRIZE

THE most meritorious research on "The effects of music" submitted to the American Psychological Association before June 1, 1921, will be awarded a prize of $500.

This sum has been placed at the disposal of the association by Thomas A. Edison, Inc. It is the wish of Mr. Edison and his associates to direct attention toward the importance of research in the psychology of music. They point out that we have to-day all too little scientific understanding of the effects, both affective and volitional, which contrasted sorts of musical selections produce on listeners of differing native endowments and training, under varying conditions of mood, season and physical condition.

Researches brought to completion during the present academic year may be submitted in competition for the Thomas A. Edison prize. Manuscripts may be sent at any time before May 31, 1921, to the undersigned, who will transmit them, without the names of the authors, to the members of the committee of award, to be designated by the American Psychological Association. Manuscripts should be submitted in form for publication.

The following topics are suggested as suitable, but the choice of subject is not limited to this list. The committee will welcome any research bearing directly on the nature of music and the way it influences people.

Classification of musical selections according to their psychological effects.
Individual differences in musical sensitivity.
Types of listeners.
Validity of introspection in studying affective responses to music.
Modification of moods by music.
Effects of familiarity and repetition: Emotional durability of various types of selections.
Effects of contrasting types of music on muscular activity.
Other objective (physiological) measurements of effects of musical stimuli.
An experimental study of music as an aid in synchronizing routine factory operations.

The problems proposed for investigation are indeed complex, the conditions extremely vari-

able and difficult of control. But the outcome of painstaking research is promising, both for general psychological theory of the affective processes, and also for our understanding of behavior as influenced by music.

For the Research Department, Thomas A. Edison, Inc.,

W. V. Bingham
Carnegie Institute of Technology,
Pittsburgh, Pa.,
October 13, 1920

THE POPULATION OF THE UNITED STATES

The Bureau of the Census has announced the population of the United States in 1920 as 105,683,108, exclusive of colonial possessions. This shows an increase of 13,710,842 since 1910, or a percentage gain of 14.9. The increase in the previous decade, between 1900 and 1910, was from 75,994,575 to 91,972,266, a percentage gain of 21 and a numerical increase of 15,977,691. The population of outlying possessions will be made public as soon as the figures for Alaska and the military and naval units abroad have been compiled. With these figures included, it is estimated that the colonies have 12,250,000 inhabitants, making the total population of the nation approximately 118,000,000.

The ranking of the states in 1920 and 1910 and their populations for these years, follow:

1920 Rank	State	1920 Pop.	1910 Pop.	1910 Rank
1	New York	10,384,144	9,113,614	1
2	Pennsylvania	8,720,159	7,665,111	2
3	Illinois	6,485,098	5,638,591	3
4	Ohio	5,759,368	4,767,121	4
5	Texas	4,661,027	3,896,542	5
6	Massachusetts	3,851,615	3,366,416	6
7	Michigan	3,667,222	2,810,173	8
8	Missouri	3,463,547	3,293,335	7
9	California	3,426,536	2,377,549	12
10	New Jersey	3,155,374	2,537,167	11
11	Indiana	2,930,544	2,700,876	9
12	Georgia	2,893,955	2,609,121	10
13	Wisconsin	2,631,839	2,333,860	13
14	North Carolina	2,556,486	2,206,287	16
15	Kentucky	2,416,013	2,289,905	14
16	Iowa	2,403,630	2,224,771	15
17	Minnesota	2,386,316	2,075,708	19
18	Alabama	2,347,255	2,138,093	18
19	Tennessee	2,337,459	2,184,789	17
20	Virginia	2,306,361	2,061,612	20
21	Oklahoma	2,027,564	1,657,155	23
22	Louisiana	1,797,798	1,656,388	24
23	Mississippi	1,789,182	1,797,114	21
24	Kansas	1,769,185	1,690,949	22
25	Arkansas	1,750,995	1,574,449	25
26	South Carolina	1,683,662	1,515,400	26
27	West Virginia	1,463,610	1,221,119	28
28	Maryland	1,449,610	1,295,346	27
29	Connecticut	1,380,385	1,114,756	31
30	Washington	1,356,316	1,141,990	30
31	Nebraska	1,295,502	1,192,214	29
32	Colorado	930,376	799,024	32
33	Florida	866,296	752,619	33
34	Oregon	783,285	672,765	35
35	Maine	767,996	742,371	34
36	North Dakota	645,730	577,056	37
37	South Dakota	635,839	583,888	36
38	Rhode Island	604,379	542,610	38
39	Montana	547,593	376,053	40
40	Utah	449,446	373,351	41
41	New Hampshire	443,083	430,572	39
42	Dist. of Columbia	437,571	331,069	43
43	Idaho	431,826	325,594	45
44	New Mexico	360,247	327,301	44
45	Vermont	352,421	355,956	42
46	Arizona	333,273	204,354	46
47	Delaware	223,003	202,322	47
48	Wyoming	194,402	145,965	48
49	Nevada	77,407	81,875	49

SCIENTIFIC NOTES AND NEWS

The autumn meeting of the National Academy of Sciences will be held in Princeton on Monday and Tuesday, November 15 and 16.

Dr. Harmon Northrop Morse, professor of chemistry and director of the chemical laboratory at the Johns Hopkins University, has died at his summer home on Chebeague Island, Me. Dr. Morse was born at Cambridge, Vt., in 1848, and became associate at the Johns Hopkins University in 1876.

King Albert of Belgium has conferred upon Dr. W. W. Keen, of Philadelphia, the honor of "Officer of the Order of the Crown."

Mr. Arthur Gibson has been appointed Dominion Entomologist, and head of the Entomological Branch of the Dominion Depart-

ment of Agriculture, to succeed the late Dr. C. Gordon Hewitt, whose death occurred in February last.

DR. THOMAS F. HUNT, dean of the college of agriculture at the University of California, has been appointed a member of the permanent committee of the International Institute of Agriculture at Rome, Italy.

MR. PAUL MOORE, director of the Information Bureau of the War Trade Board, has been appointed secretary of the Division of Research Extension of the National Research Council.

MR. R. M. WILHELM, chief of the thermometer laboratory of the Bureau of Standards, resigned in September to accept a position with the C. J. Tagliabue Manufacturing Company, of Brooklyn, New York, manufacturers of thermometric apparatus.

ROBERT HALL CRAIG, formerly sanitary engineer with the surgeon general of the army and later sanitary and hydraulic engineer with the Construction Division of the Army, Washington, D. C., and Henry Ward Banks, 3d, formerly research chemist with the Harriman Research Laboratory, New York City, and the National Biscuit Company, have formed a partnership under the name of Banks and Craig, consulting engineers and consulting chemists, with offices in New York City.

THE Iowa Physics Research Board, an organization allied with the Iowa Academy of Science, has been formed as a result of the annual meeting of the Iowa Academy held last May at the University of Iowa, at Iowa City. About twenty-five college physicists are members of the board, which is organized to give mutual help in aiding research work in physics in the state. Three members serve as an executive committee. These are Professor D. W. Morehouse, of Drake University, Professor Roy D. Weld, of Coe College, and Professor G. W. Stewart, of the University of Iowa. Professor Stewart is the secretary of the committee.

DR. HENRY A. CHRISTIAN, Hersey professor of the theory and practise of physic at the Harvard Medical School, has returned to his position at the medical school and as physician-in-chief of the Peter Bent Brigham Hospital, Boston, after a year's leave of absence spent in Washington as chairman of the Division of Medical Sciences of the National Research Council. From June 25 to July 2, 1920, he delivered five lectures at the University of Washington, Seattle, and he will deliver an address before the Mississippi Valley Medical Association at Chicago, October 27.

DR. EDWARD PHELPS ALLIS, JR., of Palais de Carnolès, Mentone, Maritime Alps, France, well known for his basic researches in comparative anatomy, is now in America, and is expected to spend three or four months in the United States previous to returning to the Allis Laboratory to resume his work.

PROFESSOR C. W. HEWLETT, of the department of physics of the University of Iowa, has returned to the university for the work of the academic year after spending the summer in the research laboratory of the General Electric Company, at Schenectady, N. Y.

HOWARD E. SIMPSON has returned to the chair of geographic geology at the University of North Dakota after a semester's leave of absence. During the leave he served as visiting professor of geology and geography in the University of Southern California.

PROFESSOR HOMER R. DILL, director of the vertebrate museum at the University of Iowa, has returned to the university after spending the summer making collections for the museum in the Hawaiian Islands and in the Billy Goat Pass region of Washington.

A GROUP of twelve physicians of the Mayo Foundation has organized the "Osler Society for the Study of Medical History." Dr. William C. MacCarty, associate professor of pathology, has been chosen president.

COOPERATIVE work has been worked out by Professor Frank Schlesinger, professor of astronomy at Yale University, between the government Observatory at Wellington, New Zealand, and the observatory of Yale University. This plan, which has received the approval of

the university corporation, involves the sending to New Zealand by the university of apparatus to photograph the stars of the southern hemisphere for compiling zone catalogues.

As has been noted in SCIENCE, a special conference was called together by the Royal Society to consider the future of the International Catalogue of Scientific Literature. We learn from *Nature* that the conference held its first meeting at Burlington House on September 28, Sir Joseph Thomson in the chair. The following is the list of delegates: Sir David Prain, Sir Arthur Schuster, Mr. J. H. Jeans, Professor H. E. Armstrong, Dr. F. A. Bather, and Dr. P. C. Mitchell, representing the Royal Society; Professor M. Knudsen, Denmark; M. A. Lacroix, France; Dr. G. van Rijnberk, Holland; Professor R. Nasini and Comm.-Ing. E. Mancini, Italy; Dr. H. Nagaoka, Japan; Mr. R. Laache, Norway; Baron Alströmer, Sweden; Dr. H. Escher, Dr. M. Godet and Dr. H. Field, Switzerland; Dr. R. M. Yerkes, Dr. L. E. Dickson, Mr. L. C. Gunnell and Dr. S. I. Franz, U. S. A.; Sir Henry Hayden and Dr. S. W. Kemp, India; Sir Thomas Muir, South Africa; Sir Edward Parrott, Queensland; Professor E. W. Skeats, Victoria; Mr. C. B. Rushton, Western Australia; and Professor A. Dendy, New Zealand. The delegates were the guests of H. M. Government at a dinner at the Carlton Hotel on September 29.

DR. RAYMOND PEARL, director of the department of biometry and vital statistics, school of hygiene and public health, Johns Hopkins University, Baltimore, will give a course of Lowell lectures in Boston beginning on December 1. The subject is "The Biology of Death," and the subjects of the separate lectures are: (1) Senescence and death; (2) The chances of death; (3) The causes of death; (4) Correlation of death rates; (5) Inheritance of life duration; (6) The trend of mortality and some of its consequences.

THE following course of public lectures on the "History of Science" is being given at Yale University under the auspices of the Gamma Alpha Society: "History of mathematics," Professor E. W. Brown; "History of chemistry," Professor John Johnston; "History of biology," Professor L. L. Woodruff; "History of psychology," Professor R. P. Angier; "History of physics," Professor H. A. Bumstead; "History of geology," Professor H. E. Gregory, and "History of astronomy," Professor Frank Schlesinger.

PRESIDENT E. A. BIRGE, of the University of Wisconsin, gave an address at the dedication of the biological buildings which have been erected at Fairport, Iowa, by the Bureau of Fisheries.

A JOINT meeting of the American Institute of Chemical Engineers, the American Section of the Society of Chemical Industry, the New York Section of the American Chemical Society and the New York Section of the American Electrochemical Society, was held at the Chemists Club in New York City on October 15. The subject of the evening was "Proposed new departures in government chemical work," and the meeting was addressed by Dr. S. G. Cottrell, director of the Bureau of Mines, and Dr. Carl Alsberg, chief of the Bureau of Chemistry, Department of Agriculture.

THE regular October meeting of the Physics Club of Philadelphia is to be held on Friday evening, October 29, at the Randal Morgan Laboratory of the University of Pennsylvania. It will be addressed on the work of the Bureau of Standards by Dr. F. C. Brown, assistant to the director.

DR. RUDOLF EUCKEN, recently retired from the chair of philosophy at the University of Jena and at one time German exchange professor at Columbia University, will give lectures during the winter semester at the University of Helsingfors.

DR. ISADORE DYER, dean of the medical school of Tulane University, known for his work on leprosy and malignant skin diseases, died at his home in New Orleans, on October 12.

THE United States Civil Service Commission announces for November 23, 1920, an open competitive examination for superintendent and director in the Bureau of Fisheries. Two vacancies exist, one for duty at Key

West, Florida, at $1,800 a year, and the other at Beaufort, N. C., at $1,500 a year, each with a possible bonus of $20 a month. Competitors are not required to report for examination at any place, but will be rated on physical ability, education and experience. Further information may be obtained by application to the Civil Service Commission, Washington, D. C.

Natural History, the journal of the American Museum of Natural History, says the largest and most mysterious land animal known in the world to-day has been named *Baluchitherium osborni* by its discoverer, C. Forster Cooper, now curator in the University Museum of Zoology, Cambridge, England. The animal is like neither an elephant, nor a rhinoceros, nor a titanothere, nor a moropus. Mr. Cooper writes that the ankle bone is certainly that of a perissodactyl and seems nearer to the rhinoceros than anything else. A giant primitive rhinoceros tooth, ten centimeters across, has been found, which indicates the presence of rhinoceroses of gigantic size in the Bugti beds of Baluchistan in Oligocene times, which was a strange faunal period. The *Baluchitherium*, if a rhinoceros, certainly had a very long neck, more like that of a gigantic giraffe than that of a horse. Two of the anterior vertebræ of this monster have recently been received in the American Museum and have been compared with all our large land animals, living and extinct, with no result. These neck vertebræ dwarf those of all the largest land animals. The Bugti beds, which have been explored by Cooper and by Pilgrim, also yield a hornless rhinoceros, *Paraceratherium*, in which the lower incisor teeth are turned downward; a hippopotamus that is typical except that it lacks front teeth; and a beautiful anthracothere called *Gelasmodon*. This gives us a glimpse into the still unknown mammalian life of southwest India.

UNIVERSITY AND EDUCATIONAL NEWS

PLANS are now being prepared for a new building for the department of chemistry of Yale University, which has hitherto carried on its work partly in the Kent Chemical Laboratory and partly in the Sheffield Chemical Laboratory. According to present plans, the new building will be located on the Pierson-Sage Square, just north of the Sloane Physics Laboratory. It will have a total floor area of 100,000 square feet; and, in addition to the usual laboratories and recitation rooms, will include an ample number of rooms for research work.

DR. GEORGE BLUMER, who resigned last spring from the deanship of the Yale Medical School, will serve for this year as clinical professor of medicine. Dr. Wilder Tileston will be associated with him with the same title, and Dr. Edward H. Hume, the dean of the medical school of Yale-in-China, who is on leave of absence in this country, will serve as visiting professor of medicine.

DR. G. H. WOOLLETT, of the University of Minnesota, has been elected associate professor of chemistry at the University of Mississippi. Dr. Woollett was formerly connected with the University of Mississippi. Dr. Victor A. Coulter, who served as a gas officer in France, has been elected assistant professor of chemistry in the same institution.

AFTER serving for twenty-five years as head of the department of horticulture and entomology, and eleven years as head of the department of entomology, of Purdue University and Experiment Station, Professor James Troop now relinquishes his position in the experiment station and will devote his time to teaching in the school of agriculture. Professor John J. Davis, formerly with the United States Bureau of Entomology is now head of the department at Purdue.

AT the University of Chicago Dr. Lester R. Dragstet has been appointed assistant professor of physiology and William Berry instructor in psychology.

DR. A. B. MACALLUM, administrative chairman of the Research Council of Canada, has been elected to the new chair of biochemistry

in McGill University, Montreal, to date from October 1. Dr. Macallum will continue his work as chairman of the Research Council until a successor has been named.

Mr. Florian A. Cajori, formerly captain in the food section of the Sanitary Corps and on duty in Jugo-Slavia with the American Relief Administration, has completed his graduate work at Yale University and accepted a position as instructor in physiological chemistry at Leland Stanford, Jr., University, in California.

Professor J. T. Wilson, F.R.S., Challis professor of anatomy in the University of Sydney, has been appointed to the chair of anatomy at the University of Cambridge.

Dr. Wilhelm Wein, professor of physics at Würzburg, has been appointed to succeed Professor Wilhelm Röntgen, who recently retired from the chair of physics at the University of Munich.

DISCUSSION AND CORRESPONDENCE

THE SPECTRUM OF MERCURY VAPOR

To the Editor of Science: In your issue of September 10, Professor C. D. Child calls attention to a greenish glow discharge through mercury vapour whose spectrum shows a continuous band throughout the greater part of the visible spectrum, with the ordinary lines superimposed. This summer, in experimenting on the electrodeless discharge of certain vapors, the writer observed a similar appearance. The method used was one previously employed by Kowalski.[1] A small quantity of mercury was introduced into a highly exhausted Pyrex bulb some 12 cm in diameter. The bulb, surrounded by the primary coil of a Tesla high-frequency outfit, was placed in an electric oven and the appearance of the discharge (if any) observed as the temperature was gradually increased.

In common with Kowalski the writer observed two distinct types of discharge. The first, a dazzling white *ring* discharge occurred at temperatures several degrees above and below 90° C., and showed the ordinary bright line spectrum. The second, a diffuse distinctly greenish glow filling the whole bulb, took place at higher temperatures and was visible until a temperature in the neighborhood of 200° C. was reached. The spectrum of this latter type showed a continuous band with superimposed lines, an appearance similar to that described by Professor Child, but *at the higher temperatures only the line 5461* was visible. The writer's observations agree with those of Kowalski, who compares the appearance he observed with an exactly similar one recorded by A. Kalahne.[2]

Professor Child states that the "radiators" giving rise to the continuous band are uncharged, and suggests that the source of this type of radiation has to do with the formation of clusters of two or three atoms which may be formed when mercury vapor is condensing. Professor Kowlaski ascribes the two appearances noted above to two ionization stages ("Ionisierungsstufe"). It would seem that a possible explanation is the following. At the lower temperatures, because of the greater mean free path, even in the case of an electric field of relatively small intensity, sufficient energy is communicated to an atom on collision to produce ionization. During recombination the line spectrum is emitted. At the higher temperatures, because of the relatively small mean free path (the vapor pressure of mercury at 160° is roughly twenty-five times that at 90°), but little energy is communicated on collision and but little, if any, ionization occurs. The line spectrum accordingly is feeble or absent. Some electrons, however, are displaced from their normal orbits, and in their return to their normal positions, radiation is emitted. Normally such a radiation would also give rise to spectral lines, but we may assume that in the case of the mercury atom with its numerous electrons, the frequent atomic impacts occurring at high temperatures alter the natural periods to such an extent that the emission is continuous over a wide range.

The writer has under way an extended study of the electrodeless discharge of certain

[1] J. Kowalski, *Physik. Zeit.*, 15, 225, 1914.

[2] A. Kalahne, *Wied. Ann.*, 65, 815, 1898.

vapors, and hopes later to publish data on this subject.

JOHN K. ROBERTSON
QUEENS'S UNIVERSITY,
KINGSTON, CANADA

AUTOPSY OF A BLACK FISH

TO THE EDITOR OF SCIENCE: On July 5, 1920, a large female Blackfish, *Globocephalus malas*, a species of whale sixteen feet long came ashore near Woods Hole, Mass., and was brought to the Fish Commission Laboratory at this place for autopsy. The task was new to all present and when a large sac capable of holding a pailful or two was seen near the posterior end of the body, it was at once recognized as probably the empty bladder. This, however, proved to be incorrect for the empty urinary bladder was found near as a hard, flesh-colored organ contracted to the size of a man's large elongated fist. The sac when more closely examined was found to be a recently delivered uterus, completely relaxed, upon the inner surface of which the site of the placenta could be plainly made out and with its open mouthed sinuses capable of receiving the tips of a little finger. This therefore was probably an unique case of death from post-partum hemorrhage, damp bed and absence of a marine accoucheur with his ergot. A few days later the history of the case was completed by the finding of the infant, a youngster about three feet in length, also cast ashore near where the body of the mother was found.

There is no doubt the character of the case would certainly have been undiagnosed had there not been present at the post-mortum, an old general medical practitioner who recognized first that the body of the animal showed an almost exsanguine state, corroborated later by the condition of the relaxed uterus.

G. A. MACCALLUM
WOODS HOLE, MASS.,
July 26, 1920

QUOTATIONS

THE NATIONAL BOTANIC GARDEN

THE plan for the creation of a national Botanic Garden and arboretum that will be comparable with government gardens in other countries, and with public gardens in cities of the United States, should not be allowed to rest. There is force and sound argument in the proposal and no contrary argument. The present national Botanic Garden is national only in its name and in the fact that it is maintained at a slight cost to the nation. It is not national in its exhibit of plant forms. It was a pleasing little spot when the capital was a village. It carries one's thought back to when the mighty Library of Congress was housed in one small room in the Capitol. The Botanic Garden has made little growth in fifty years because it could not expand outside of its tall iron fence. Now the little space within that fence is being dedicated to monuments.

The weight of opinion among government and private botanists and landscape architects is that the Mount Hamilton tract should be the site of the great new and really national Botanic Garden. It fronts on one of the main boulevards. It is already accessible by steam and electric railroads. It adjoins the vast public park which the government is building up from the bottom, the marshes and the margins of the Eastern branch. It thus fits into and becomes a part of the park system. These are among the reasons which botanists urge to bring the matter into public favor. But to them the strong reasons are that in this tract of land are high hills, steep slopes, gentle slopes, thick woods with many varieties of timber, deep ravines, meadows, marshes, brooks and rivulets, and about all kinds of soil which all kinds of American plants pick out for home.

It is a great idea that the United States should have a Botanic Garden of which all Americans could say, "It is the greatest thing of its kind on earth."—Washington *Evening Star*.

A NEW BIOLOGICAL JOURNAL

DURING the past two decades the development of ecological studies in this country has been rapid. Five years ago, as a result of continued and insistent demand, the Ecological Society of America was organized and at once included in its membership botanists

and zoologists of the pure biological sciences, foresters and economic entomologists of the applied sciences, and climatologists and geographers, whose work is closely connected with ecology. Beginning with the study of statics, the description of conditions as they exist, the science progressed rapidly into dynamics, the investigation of the behavior of plants and animals and the development of the communities in which they live. Now, by refined observation and precise experiment, ecology seeks to discover the fundamental causes which control the natural existence of living things. As ecology has broadened in its scope, so also has it deepened; as it has included questions of greater and more fundamental biological importance, so has it attracted investigators in larger numbers and of greater ability; as the products of ecological research have become more numerous and more scholarly, so has the necessity grown for adequate means of publication.

Ecology, the official publication of the Ecological Society of America, is the latest addition to American biological periodicals. Yet it does not add to the number of scientific journals, for it is a continuation of the old and useful *Plant World*, which for several years has been largely ecological. At the St. Louis meeting of the affiliated scientific societies the Plant World Association most generously turned over its magazine, free from all liabilities, to the Ecological Society. But the new title, the new cover, the new volume number, the new editorial board, and above all the opening of its pages to articles on all branches of ecology, stamp it as a distinctly new periodical. *Ecology* begins its career under favorable circumstances. As the official organ of a growing society it is not wholly dependent on a subscription list for its financial stability. It is printed by the New Era Printing Company and managed through the Brooklyn Botanic Garden, the editorial control remaining with the society, undoubtedly fortunate arrangements. Its editorial board, headed by Major Barrington Moore, comprises fifteen men chosen from the leading ecologists of the country and representing a wide diversity of interests and activities.

The first two numbers set a high standard and illustrate the broad scope of the science. The editor-in-chief contributes a short article on the scope of ecology; Ellsworth Huntington correlates atmospheric conditions with the prevalence of influenza and pneumonia; A. E. Douglass describes a new method of correlating tree-growth with precipitation; C. E. Esterly describes experiments on the behavior of a copepod in relation to its diurnal migration; W. E. Praeger contributes a note on the ecology of herons; E. T. Wherry, using his new method of determining soil acidity, discusses the distribution of plants around salt marshes; and J. V. Hoffmann describes the establishment of a Douglas fir forest. In the second number E. B. Powers publishes the results of his experiments on the influence of temperature and concentration on the toxicity of salts to fishes; W. H. Burkholder discusses the effect of soil temperatures on healthy and diseased bean plants; C. C. Forsaith describes the anatomical reduction in alpine plants from the higher White Mountains; and there is presented the first part of an extensive report on the ecology of the plants and animals of Mount Marcy, New York, by Messrs. Adams, Burns, Hankinson, Moore and Taylor, comprising the committee on cooperation of the Ecological Society. From the foregoing it is evident that the first numbers contain material of interest to climatologists, marine biologists, zoologists, botanists, agronomists and foresters as well as to geographers, and even to the medical profession.

Ecology is an illustrated quarterly, octavo; a volume of four numbers will contain 300 or more pages.

H. A. Gleason

SPECIAL ARTICLES

CHROMOSOMAL DUPLICATION AND MENDELIAN PHENOMENA IN DATURA MUTANTS

There are 12 separate and distinct mutants of the Jimson weed (*Datura Stramonium*) which have recurred with more or less fre-

quency in our cultures of this species during the past six years. The majority of these 12 mutants have been already briefly described or figured elsewhere.[1]

The twelve have certain characteristics which distinguish them from the normal stock from which they arose. They are of feebler growth than normals and have a relatively high degree of pollen sterility, while pollen from normals is relatively good with less than 5 per cent. obviously imperfect grains when examined in unstained condition. The breeding behavior of the twelve is peculiar in that the mutant character is transmitted almost entirely through the female sex. Usually about one quarter or less of the offspring only from a given mutant reproduce the parental mutant type. The pollen entirely fails to transmit the mutant character, or transmits it only to a small percentage of its offspring. This is concluded from the fact that normal female plants crossed with mutant pollen produce no mutant offspring or only a small percentage, and from the fact that the pollen of any of the 12 mutants seems to be no more potent in reproducing the mutants than pollen from normals.

Another type of mutant, provisionally called "New Species" because of the difficulty or impossibility of crossing it with normals has relatively good pollen and breeds true.

A study has been begun by the present authors of the relationship which exists in *Datura* between the cytological condition and the related phenomena of mutation and Mendelian inheritance. The cytological findings are based on counts of over 350 groups of chromosomes. We can confirm the report of others as to the presence of 12 pairs of chromosomes in the somatic cells of normal jimsons. The somatic number is accordingly twenty-four in contrast to the gametic number twelve. Chromosomal counts from the first division of pollen mother cells show that the gametic number in all the 12 mutants is apparently 12 and 13 giving a calculated somatic number of 25 instead of the 24 found in normals. Whereas in normals all the gametes have 12 chromosomes, in our dozen mutants presumably half the gametes have 12 and half have 13 chromosomes. Apparently in the 13-chromosome gamete the extra chromosome is brought in by a duplication of one of the regular twelve.

The suggestion lies near at hand that each of our 12 mutants is associated with, if not actually determined by, the duplication of a different individual chromosome to make up the calculated total of 25 characteristic of their somatic cells.

If each of our dozen mutants is characterized by the presence of an additional chromosome in a definite one of the 12 chromosome sets, it should be possible by breeding tests to identify the mutant which has as its extra chromosome the one which carries the gene for any particular Mendelian character. This we apparently have been able to do for two of the twelve sets.

The mutant *Poinsettia* (1) which appears to be caused by a duplication of one of the chromosomes carrying determiners for purple or white flower color will serve as an example. *Poinsettia* plants have 2 chromosomes in all the sets except in the one carrying the gene for flower pigmentation, which has three. Considering only the latter, we may have *Poinsettia* mutants, as regards their purple pigment, either triplex PPP, duplex PPp, simplex Ppp or nulliplex ppp.

A duplex purple *Poinsettia* with the formula PPp should, if the chromosomes assort at random, be expected to form egg cells of the following types: $2P + p + pp + 2Pp$. The pollen grains should have the same constitution; but, since the *Poinsettia* character fails to be carried by the pollen to any significant extent, the effective male gametes are $2P + p$. Combining male and female gametes in selfing we expect the following zygotes: $4PP + 4Pp + pp + 2PPP + 5PPp + 2Ppp$. The zygotes with 2 chromosomes in the set are normals, the zygotes with 3 chromosomes are *Poinsettia* mutants. We should have

[1] Blakeslee, A. F., and Avery, B. T., "Mutations in the Jimson Weed," *Jour. of Heredity*, X., 111–120, Figs. 5–15, March, 1919.

therefore among the normals 8 purples to 1 white, and among the Poinsettias 9 purples to no whites. The expectation of an equal number of normals and mutants is practically never realized, probably because of differential mortality in early stages favoring the normals.

A simplex purple heterozygote with the formula Ppp should have the following female gametic formula: $P + 2p + 2Pp + pp$. Its effective male gametes should be $P + 2p$ Selfing a simplex purple heterozygote therefore should give offspring showing a ratio of purples to whites in normals of 5:4 and in the *Poinsettias* of 7:2. Several *Poinsettia* plants of these two heterozygous purple types have been selfed and found to give color ratios in their offspring in close agreement with the calculated values above. When *Poinsettia* mutants are made heterozygous for the other known Mendelian factors, segregation occurs in normal manner giving the customary 3:1 ratio for the characters involved, in both normals and *Poinsettias*.

Two of the 12 mutants have each a single varietal type, which may be due to factors modifying the expression of the more typical complex. In addition two new mutant forms have arisen each of which in appearance seems to be a combination of two of the typical 12 recurrent mutants. It has not been possible as yet to count their chromosomes nor to study their breeding behavior.

We have discussed the duplication of a single chromosome from only one of the 12 sets, producing mutants with 25 somatic chromosomes, with 3 chromosomes in one set and 2 chromosomes in the other 11. We have obtained in addition the duplication of a single chromosome from each of the 12 sets producing a mutant triploid for all the 12 homologous sets.

The duplication may bring about a doubling of all the chromosomes, producing Gigas-like tetraploid mutants—the "New Species" type already mentioned. Such tetraploid plants have presumably 48 chromosomes in somatic cells and 24 in the gametes. From a study of the color ratios in over eight thousand offspring from tetraploid plants, it is possible to assert with some confidence that independent assortment of the chromosomes in the homologous sets of such tetraploid mutants is the rule. Selfed duplex purple heterozygotes throw 35 purples to 1 white, while the back-cross gives a ratio of 5:1. Simplex purple heterozygotes on the other hand give 3:1 ratios when selfed and 1:1 ratios when back-crossed.

Evidence is at hand which indicates that we may have plants with other of the theoretically possible combinations of chromosomes than those mentioned in the present paper.

The significance of the findings in *Datura* in relation to the peculiarities in inheritance in *Gigas* and other mutant types in *Œnothera* will be pointed out later. It is hoped that it may be possible to publish in the near future a series of more detailed papers on the phenomena of chromosomal duplication in the *Daturas*. The present preliminary publication will suffice to emphasize the distinction which must be kept in mind between chromosomal mutations and mutations affecting only single genes.

ALBERT F. BLAKESLEE.
JOHN BELLING,
M. E. FARNHAM
CARNEGIE STATION FOR
EXPERIMENTAL EVOLUTION

THE AMERICAN CHEMICAL SOCIETY.

DIVISION OF BIOLOGICAL CHEMISTRY

R. A. Gortner, *chairman*
A. W. Dox, *secretary*

The fat soluble A. vitamine and xerophthalmia: A. D. EMMETT and MARGUERITE STURTEVANT. The authors agree with McCollum that xerophthalmia is a disease which is due primarily to a lack of the fat-soluble A. vitamine. Experiments with rats fed on different planes of nutrition, all with the same precautions as to sanitation, eliminate the idea that xerophthalmia is primarily infectious as Bulley claims. The disease can not be cured by local treatment. It responds quickly to treatment *per os* with extracts containing the fat-soluble A. vitamine. It is not contagious. It is primarily a deficiency disease which in turn may bring about secondary infectious conditions.

Biochemical changes in the flesh of beef animals during partial starvation: C. R. MOULTON. Fat

yearling beef steers were subjected to low planes of nutrition. The extreme low plane involved a loss of 81.5 kilos in body weight, or 30 per cent. This included a loss of 44.3 kilos of fat and 10.9 kilos of protein. The total fat in the animal was reduced from 18 to 2 per cent. The skeletal fat even was reduced to 2.9 per cent., showing extreme emaciation. Not only was there a loss in total body protein but the flesh suffered depletion in total nitrogen from 3.58 per cent. to 3.18 per cent., amounting to 10 per cent. of the normal. The water content of the flesh was normal. The soluble nitrogen and albumins were reduced one third. The per cent. of extractive nitrogen was lowered 10 per cent. as was also the concentration per 100 grams water. The relation of extractives to total protein remained constant. A storage of body protein was indicated since the muscle fibers retained their structure and general form.

Scurvy in poultry: J. S. HUGHES and F. E. FOX.

The relation of the vitamine content of feed to the vitamine content of milk produced: J. S. HUGHES and J. B. FITCH.

Studies in embryo-chemistry. (1) *The enzymes of the embryonic pancreas. A. Lipase:* VICTOR E. LEVINE and EBEN J. CAREY. Pig embryos ranging from 45 to 260 millimeters were employed. The pancreas was removed from the embryo, the total number of organs per litter weighed, triturated and made up with mammalian Ringer solution, the salts of which have an accelerating or activating effect upon lipase. The preparation was centrifuged and the supernatant liquid used. The dilution was such that 1 c.c. was equivalent to 10 mg. tissue. The gall bladder and contents were also removed, ground and diluted with distilled water. Blood was obtained from the umbilical vein. Ethyl butyrate or olive oil was used as substrate. Controls were kept with substrate, enzyme preparation, bile, bile and enzyme, blood, blood and enzyme. After an incubation period of 18 hours at 37.5° C. the flasks were titrated with n/70NaOH, using phenolphthalein as indicator. Titrations with olive oil were made in 50 per cent. alcohol. With an increase in the age of the embryo there was observed not only an increase in the lipolytic activity due to the increased weight of the organ, but also an increased activity per milligram of tissue. The gall bladder showed the presence of bile salts at a very early stage, for striking accelerations in the lipolytic process were demonstrable. The effect of bile salts on lipolysis is far more sensitive a test for these salts than any purely chemical one. Embryonic blood was found to contain an accelerator second in vigor to the bile salts. The increased activity can not be ascribed to an enzyme present in blood, since whole blood or serum after long boiling is still effective. The accelerating substance corresponds to auxo-lipase in the blood of the adult.

A new test for sugar in the urine: VICTOR E. LEVINE. A solution of 2 per cent. sodium tellurite in 10 per cent. sodium carbonate is the reagent employed. The reaction involves the reduction of the tellurite to elemental tellurium. With small amounts of sugar the free tellurium forms a colloidal solution, which is a characteristic brown in direct light and a gray black in reflected light; with large amounts a gray black precipitate of tellurium results. The test is carried out by heating for several minutes 5 c.c. reagent with 1 to 2 c.c. urine. Carbohydrates possessing a free carbonyl group respond to the test. Pentoses (arabinose, rhamnose, xylose); hexoses (glucose, fructose, galactose); dihexoses (lactose, maltose), give positive reactions. Sucrose, raffinose and polysaccharides (cellulose, glycogen, inulin, starch), glycoproteins, nucleoproteins and cerebrosides reduce only after hydrolysis and subsequent neutralization. Aldehydes and ketones do not cause reduction of alkaline tellurite. Formic acid, chloroform, nucleoprotein, thymol, uric acid and creatinine also do not interfere with the test.

Disodium phosphate is a specific catalyst for the quantitative oxidation of glucose to CO_2 with H_2O_2 at 37°: EDGAR J. WITZEMANN. W. Löb (*Biochem. Zt.* 32: 43 (1911)) claimed to have shown by inadequate methods that mixtures of 1/3 M solutions of Na_2HPO_4 and NaH_2PO_4, having the OH ion concentration of normal blood, catalyse the oxidation of glucose with H_2O_2. It was found that glucose, and its transformation products, may be determined quantitatively by oxidizing them to CO_2 with $KMnO_4$ first in hot alkaline solution and afterwards in H_2SO_4 solution. By this method Löb's statements were conclusively proved. Moreover it was shown that the glucose not recovered by the $KMnO_4$ method, after the H_2O_2 oxidation, could be recovered during the oxidation as CO_2. The oxidation of glucose to CO_2 with H_2O_2 at 37° C. in the presence of the phosphate mixture is quantitative. The Na_2HPO_4 is the active compound in the system and in this instance functions as a true oxidizing enzyme without having any other characteristic property of an enzyme. NaOH,

$NaHCO_3$ and Na_2CO_3 alone or in mixtures do not produce this effect. Mixed with Na_2HPO_4 they diminish or destroy its effect.

The standardization of the borax solubility test for commercial casein and its application: HARPER F. ZOLLER. The viscosity of casein in borax solutions shows that the maximum viscosity is obtained at a hydrogen ion concentration of p_H 8.15, while at a p_H of 8.9–9.1 the viscosity is less but constant owing to the buffing effect of borax in this region. The importance of conducting the borax test in this buffered region is discussed. The great variation in the viscosity of casein solutions at different concentrations of casein is utilized in the improved test by choosing a concentration which will bring out the difference in physical constitution of caseins prepared under safe and dangerous temperature conditions. The viscosities of several caseins in borax solutions is given to show that differences in the physical structure of caseins have greater influence upon their viscosity than the normal contaminating substances present in commercial caseins. High temperature caseins always exhibit a comparatively great initial viscosity. The improved casein-borax test is given. The essential changes include low solution temperatures, reduced concentration of casein and increased concentration of borax. These changes are based upon purely physico-chemical relationships. The value of the casein-borax test is defined as an accurate means of differentiating between low and high temperature caseins.

The precipitation of grain curd casein from pasteurized milk including pasteurized sweet cream buttermilk: HARPER F. ZOLLER. The grain curd method can be successfully applied to the separation of casein from pasteurized milks only when higher precipitating temperatures are used. The optimum precipitating temperatures are exhibited in the form of curves for the different observed conditions of pasteurization. The marked differences in the physical nature of the curd from pasteurized and unpasteurized milks are strikingly revealed by the grain curd method of precipitation. Attempts to overcome some of these physical effects by the use of organic acids as precipitants and with coprecipitants are described. The advisability of using rennin to precipitate casein from pasteurized milk is dismissed because of the time required and the large quantity of mineral entrained in the curd. Large centrifugals are urged to wash and press the casein precipitated by the grain curd method from pasteurized and normal milk. The phenomena of the retrogression of the hydrogen ion was discovered in the whey and wash water bathing the curd precipitated from pasteurized milk by the grain curd process at 34° C. This rapid decrease in acidity is attributed to the excessive precipitation of alkaline earth phosphates during pasteurization, and their subsequent resolution at the expense of the hydrogen ion as they are brought into ready contact by the soft dispersing curd. The great check in the rate of this retrogression wrought by using higher temperatures for precipitation is believed to be due to the engulfing of these precipitated phosphates by the firming of the curd; thus the intimate contact between the solution and the phosphates is reduced.

Grain curd casein: MANSFIELD CLARK, HARPER F. ZOLLER, A. O. DAHLBERG and A. C. WEIMER. To meet the demand for a high-grade commercial casein required in the manufacture of the glue to be used in the construction of aircraft, a controlled method of manufacture was devised and put into larger-scale operation. This method was based primarily upon the properties of casein as an amphoteric electrolyte, the chief control being exercised through the adjustment of the hydrogen ion concentration at which the casein is precipitated and at which it is washed. The casein so produced met the analytical requirements of the government specifications, gave promise of being suitable for the manufacture of a high-grade glue and possessed a uniformity in physical characteristics which would doubtless have eliminated the necessity for troublesome changes in glue formulas. Some laboratory data and certain details of manufacture are presented.

Chlorine as a flu preventive: HARRISON HALE. The use of chlorine as a flu preventive when breathed for 5 minutes daily in air containing 43 to 275 parts of chlorine per million was tested at the University of Arkansas, February, 1920. More than 800 treatments were given to 184 different individuals, none of whom developed the flu except one who began to feel sick within a few hours after his first treatment, and whose case seems to have developed previously. The evidence tends to show that chlorine is a preventive, but is not conclusive because of the rapid decrease in the number of flu cases.

The synthesis of lysine in the organism of the white rat: HOWARD B. LEWIS and LUCIE E. ROOT.

Respiration in cereals. The respiration of sprouted wheat. The respiration of rice paddy

and milled rice. The respiration of frosted wheat plants. The respiration of wheat plants infected with stem rust: C. H. BAILEY and A. M. GUJAR.

The etiology of limberneck in fowls: S. D. WILKINS and R. A. DUTCHER. Many theories and beliefs are extant relative to the primary causes of limberneck in poultry. Attempts have been made at the Minnesota Station to produce limberneck by the following methods: (1) Dietary treatment. (2) Feeding and injecting *B. botulinus* and its toxin. (3) Feeding spoiled foods. (4) Feeding salts and brines. (5) Feeding inorganic poisons. (6) Feeding larvæ of certain flies (*Lucilia cæsar*). (7) Feeding maggots from various sources. Negative results were obtained in all trials except when larvæ of *Lucilia cæsar* were fed. These larvæ were obtained from ova deposited on limberneck carcasses.

The relation of vitamines to the development of sex organs in cockerels: S. D. WILKINS and R. A. DUTCHER. White Leghorn cockerels of uniform age and weight were divided into two groups. Group I. received a diet of polished rice only, while Group II. received a diet of polished rice, supplemented by 2 grams of green alfalfa, daily. The testes were found, after 30 days, to have atrophied, in Group I., in spite of the fact that some birds had not lost in weight, showing that atrophy of organs is not necessarily accompanied by general inanition. In Group II. the testes were found to be practically normal for birds of that age and breed.

Effect of vitamine deficiency on various species of animals. I. The production of xerophthalmia in the rabbit: V. E. NELSON and A. R. LAMB. A diet deficient in the fat-soluble vitamine will produce a disease of the eyes of rats which is called xerophthalmia. This condition has been repeatedly produced in rats, and is said to have occurred in children, but has not been reported in any other species. We have begun a study of the relative requirements of various species for this substance. On a ration deficient in fat-soluble A young rabbits grew for a few weeks, but at the end of 60 days lost weight and became nearly blind. Butter-fat effected a cure. It is suggested that herbivorous animals may require more of this vitamine than the rat.

The rôle of vitamines in the growth of yeast. I. Are vitamines essential? E. I. FULMER, V. E. NELSON, F. F. SHERWOOD. Evidence indicates Water Soluble B is unnecessary for yeast growth. Yeast has been growing months in a vitamine free medium at two thirds the rate manifested in wort. Alcoholic extract of alfalfa stimulates growth. Heating the extract with alkali does not destroy this effect. Alcoholic extracted malt gives results like untreated malt. The ammonia content of the medium influences growth. There is an optimum concentration variations from which materially decrease the crop. One is unwarranted stating this or that substance is indispensable until the best synthetic medium is developed.

A correction of two previous papers: 1. Rate of recovery from the action of fluorite rays. 2. Sensitization to heat due to exposure to light of short wave lengths. The graphical representation of hydrogen ion concentration. Notes concerning formol titration of nitrogen: W. P. BOVIE.

CHARLES L. PARSONS,
Secretary

(*To be continued*)

THE SUMMER MEETING OF THE AMERICAN MATHEMATICAL SOCIETY

THE twenty-seventh summer meeting and ninth colloquium of the American Mathematical Society were held at the University of Chicago on September 7–11. The meeting was preceded on September 6 by a meeting of the Mathematical Association of America and extended over three sessions, lasting until noon on September 8. On the afternoon of that day the colloquium opened. The colloquium consisted of two courses of five lectures each, on "Dynamical Systems" by Professor G. D. Birkhoff, of Harvard University, and on "Topics from the theory of functions of infinitely many variables" by Professor F. R. Moulton, of the University of Chicago. The attendance at the colloquium was eighty-eight, exceeding by nearly twenty the previous record for attendance at a colloquium.

The attendance at the regular sessions of the Society included more than one hundred and twenty persons among whom were nearly one hundred members of the society. One hundred and sixteen persons were present at a joint dinner of the society and the association held on the evening of September 7. Excellent accommodations had been provided at Hitchcock and Beecher Halls, and at the Quadrangle Club, which was most generously put at the disposal of attending members. A resolution expressing to the department of mathematics of the University of

Chicago the society's appreciation and gratitude was unanimously adopted.

Upon recommendation of the council, the society voted to raise the annual dues from five to six dollars and the life-membership fee from fifty to seventy-five dollars. Thirteen new members were elected at this meeting: Dr. R. F. Borden, Brown University; Dr. Tso Chiang, Nan Kai College, Tientsin, China; Professor H. M. Dadourian, Trinity College, Hartford, Conn.; Mr. J. Douglas, Columbia University; Mr. P. Franklin, Princeton University; Mr. C. F. Green, University of Illinois; Captain R. S. Hoar, Ordnance School, Aberdeen, Md.; Professor Jessie M. Jacobs, University of Texas; Mr. E. L. Post, Columbia University; Professor C. D. Rice, University of Texas; Mr. L. G. Simon, New York City; Professor J. E. Stocker, Lehigh University; Mr. Tsao-Shing Yang, Syracuse University. Twenty-one applications for membership in the society were received.

Vice-president Richardson presided at the sessions of Tuesday and Wednesday forenoons; Professor M. W. Haskell presided on Tuesday afternoon. The following thirty-four papers were read at this meeting:

On the projective generation of cyclides: ARNOLD EMCH.

A generalization of the strophoid: J. H. WEAVER.

On the relative distribution of the real roots of two real polynomials: C. F. GUMMER.

The polyadic expansion of a number: A. A. BENNETT.

On the location of the roots of the jacobian of two binary forms: J. L. WALSH.

On the transformation of convex point sets: J. L. WALSH.

On Kakeya's minimum area problem: W. B. FORD.

On completely continuous linear transformation: T. H. HILDEBRANDT.

Integral equations in which the kernel is quadratic in the parameter: ANNA J. PELL.

Annihilators of modular invariants: OLIVE C. HAZLETT.

Construction of multiple correspondences between two algebraic curves: VIRGIL SNYDER and F. R. SHARPE.

Note on a method of proof in the theory of Fourier's series: DUNHAM JACKSON.

On the drift of spinning projectiles: J. W. CAMPBELL.

Functions of infinitely many variables in Hilbert space: W. L. HART.

A property of continuity: D. C. GILLESPIE.

Periodic orbits of type 2/1: L. A. HOPKINS.

Note on the median of a set of numbers: DUNHAM JACKSON.

An application to Weierstrass's function of the generalized derivative of type (C1): C. N. MOORE.

A method of graduating curves: L. R. FORD.

Note on a generalization of a theorem of Baire: E. W. CHITTENDEN.

On classes of functions defined in terms of relatively uniform convergence: E. W. CHITTENDEN.

On the relation between the Hilbert space and the calcul fonctionnel of Fréchet: E. W. CHITTENDEN.

A generalization of the Fourier cosine series: J. L. WALSH.

Note on a class of polynomials of approximation: DUNHAM JACKSON.

Reciprocal subgroups of an abelian group: G. A. MILLER.

Characteristic lines of transformations: E. R. HEDRICK, L. INGOLD and W. D. A. WESTFALL.

Pseudo-differentiation of a summable function: W. L. HART.

Five notes on Einstein's theory of gravitation: EDWARD KASNER.

On the convergence of certain trigonometric approximations: DUNHAM JACKSON.

Note on the Picard method of successive approximations: DUNHAM JACKSON.

Symbolic notation in the theory of modular invariants: OLIVE C. HAZLETT.

On the Fourier coefficients of a continuous function: T. H. GRONWALL.

A sequence of polynomials connected with the n-th root of unity: T. H. GRONWALL.

Upper bounds of the coefficients in conformal mapping: T. H. GRONWALL.

ARNOLD DRESDEN,
Acting Secretary

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, OCTOBER 29, 1920

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE AGRONOMIST'S PART IN THE WORLD'S FOOD SUPPLY[1]

THE welfare of mankind is intimately bound up with the world's food supply. Not that man can "live by bread alone," but he is unable to devote himself to the higher phases of an advancing civilization if he is conscious of the gnawings of hunger. Since the shortage in various food products during the war, people generally have taken a much keener interest in the whole question of food supply. The old statement that "we never miss the water till the well runs dry" is here exemplified. So long as the grocer had plenty of flour and sugar most people considered the supply in much the same way as they considered the supply of air. The only worry was to find money with which to purchase needed articles.

When it became necessary to go to a dozen stores before being able to buy any sugar, and then only a pound or two; when the meat allowance was restricted; and when white flour had to be supplemented by all kinds of substitutes—then people began to realize that the supply of food might not be inexhaustible.

The shortage of food during the war has been a good lesson for the people of the United States. It has taught them what some of the peoples of Asia have been so often forced by famine to realize, namely, that food can be had only when a supply is available, and that this supply may at times be far short of actual needs. Conditions during the war were of course unusual; we hope they will never recur. I do not at this time desire to consider the food shortage due to the war but rather the whole food situation as it is likely to affect mankind in the future as the

[1] Address of the president of the American Society of Agronomy, Springfield, Mass., October 18, 1920.

population of the earth increases. There will be of course temporary local short-time food shortages due to unfavorable seasons, wars, or other unusual conditions. These situations will have to be met as best they can at the time. The thing to which I should like to direct attention at present is not this temporary condition of famine but rather the means by which people may be fed when the world becomes much more populous than it now is. Having an earth, the best land of which is already producing crops without any great surplus, how is it going to be possible for nations to grow, cities to be built, and civilization to advance? Is there a limit to the number of people for whom the earth can supply food, or can the increase go on indefinitely?

As a small boy I remember going through what seemed to me to be an immense forest with a man who said it contained enough timber to last the whole United States for a thousand years. In later years when I became old enough to make the calculation, I found that this particular body of timber would not furnish America's needs for a single year.

In the early days of the settlement of the west many who saw the large rivers made the statement that the water of these rivers could never be exhausted by irrigation. The supply was said to be limitless. Experience has shown that the water of many of these streams was exhausted before more than a fraction of the adjacent land could be served. Thus, all things have their limits. There is a limit to the number of people a given area of land can sustain, and since the area of land is practically constant there must be a limit to the number of people that can be fed. The number of course depends entirely on how fully the resources of the earth are utilized. It is possible greatly to increase production. I wish particularly to call attention to the methods by which the agronomist may assist in accomplishing this end.

I am not an alarmist. I do not wish to appear as one who is trying to stir people up unnecessarily. I should not even like to take the responsibility assumed by Sir William Crookes, who, in his presidential address before the British Association for the Advancement of Science in 1898, set a date when the shortage of food would begin to be felt. I do not believe that there is sufficient data available for any one to be so definite. A few facts, however, may be used to help in clarifying our minds on the subject.

It is well known that the population of all important countries of the world is gradually increasing. During the 110 years from 1800 to 1910 the population of the world increased from 640,000,000 to 1,600,000,000, or an increase of 152 per cent. Only a few generations ago there were vast continents of unsettled fertile land waiting to absorb the overflow from the populous parts of the world. There are still many large tracts of land that are not settled, but it is obvious to all who have made a study of the subject that the better lands are rapidly being put under cultivation, and only the more remote and more unfavorable areas remain. This does not say that there is not still available much excellent land, but let us consider the United States as an example.

In 1790 the population of the entire country was 3,929,214; by 1840 it had reached 17,059,453; while the 1920 census shows it to be more than 105,000,000. A century ago only the east coast was settled; the great heart of the agricultural land had not been touched. The rapidity of settlement of the middle northwest is indicated by the fact that between 1800 and 1820 the population of Ohio, Indiana, Illinois, Michigan, Wisconsin and Iowa was increased from 50,240 to 792,719, and by 1840 it had reached 2,967,840. Today the entire country has been thoroughly explored and the better land has been producing for nearly a generation.

In order to see just how our production and consumption have balanced during the last three score and ten years—the allotted time of man—let us examine the figures for wheat, probably our best index crop.

WHEAT PRODUCTION AND EXPORT IN UNITED STATES AVERAGE BY 10-YEAR PERIODS, 1849–1919

Decades	Bushels Produced per Year (Average)	Bushels Exported per Year	Per Cent. Exported
1849	100,486,000	7,535,901	7.5
59–68[1]	190,395,750	21,475,072	11.3
69–78	285,951,600	73,634,732	25.7
79–88	446,587,600	133,703,079	29.9
89–98	495,184,800	165,377,944	33.3
99–1908 ..	651,643,800	152,533,604	23.4
1909–18.....	754,471,400	172,400,807	22.8

In 1849 we produced approximately one hundred million bushels of wheat in the country, only 7.5 per cent. of which was exported. With the rapid settlement of the west production rose till during the decade 1879–1888 it reached 446,587,600 bushels, 33.3 per cent. of which was exported. Thus new productive land was brought under cultivation much faster proportionately than population increased. After this time, however, the population so gained on production that during the next decade only 23.4 per cent. of the wheat produced was exported, and during the ten years from 1909–1918 the exports averaged 22.8 per cent. of the production. This figure was much increased by extra exports during the war. During the years immediately preceding the war the exportation of wheat had almost ceased. In 1880, 80.4 per cent. of our exports consisted of agricultural products, where as in 1910 the percentage had dropped to 50.9.

These figures are significant since they show that, even in a country like the United States where the area and the resources seem to be almost limitless, it will not be long possible to continue to feed other than our own increasing population.

A condition that helps to bring this about is the rapidly increasing proportion of our city dwelling population. In 1820 only 4.93 per cent. were urban. In 1880 it had reached 29.5 per cent. leaving still 70.5 per cent. rural; ten years later 36.1 per cent. were urban and 63.9 per cent. rural; in 1900 only 40.5 per cent. were urban; and by 1910, 46.3 per cent. were urban and only 53.7 per cent. rural. Indications from the 1920 census are that this year will show more people living in cities than in the rural districts.

[2] Average of only 4 years.

With a condition of this kind the food situation is likely to become more acute than where most of the population live on the farm where they can more quickly influence the rate of food production. With the growth of many large cities and with the complex systems of modern transportation and exchange, the food question tends more and more to become a single whole-world problem rather than numerous small local problems affecting the smaller communities. With our modern systems unobstructed by war we shall probably never again have such devastating local famines as were so common in past generations in India, China, and Russia during years when there was an abundance in other parts of the world.

The situation as it appears to me is this: We live in a world with an increasing population. This increase can not expand indefinitely to fertile unoccupied lands since these lands are becoming scarce. The food supply must be increased as fast as the population increases, since food supply is the chief limiting factor in population growth.

There is no immediate cause for alarm, but it is the duty of scientists and statesmen to look to the future. We must not be content to be like Sam the negro who took his stove to his boss and offered it for sale for a fraction of its value. On being asked if he would not need it next winter he said he would but that winter was three months away while the circus was to-morrow.

Satisfying the needs of to-day is not sufficient: we must maintain a forward-looking attitude. It is impossible to make large increases in production quickly; years of preparation and work will be required to do anything of permanent value. An adequate solution of the world's food problem can be made only by deliberate planning. All factors involved must be considered and a world-wide program of work initiated, for the world is not a unit in production and in consumption.

The problem will involve a great variety of business and scientific interests. Credit, transportation, manufacturing and mechanics must all be called on to do their part. What we are now most interested in, however, is the contribution of the agronomist. What is his part in the world's food problem?

An examination of the question indicates that his part is a large one. While it is not entirely clear just what is included under the word "agronomy," the general understanding is that it has to do with anything affecting crop production, and since the food supply is in the last analysis a question of crop production, it would appear that the agronomist has a great responsibility in seeing that the people of the world do not want for something to eat.

Let us see what means he has available to meet this responsibility. We have already shown that the increasing population will call for increased production. This increase can be met in just two ways: First, by extending the producing area, and secondly, by increasing the acre-yield of the present cultivated area.

The method of enlarging the agricultural area will be discussed under the following four headings: (1) Increasing the irrigated area, (2) extending dry-farming, (3) drainage of wet lands, and (4) reclamation of alkali lands.

Of course there are uncultivated lands in the world that will not require any of the methods of reclamation mentioned above to make them productive. They may be inaccessible, or for some economic reason it may not pay to cultivate them even though they are fertile. In cases of this kind the agronomist has no particular responsibility. He is concerned primarily in solving the problems which call for his particular training in science. Since the better lands are already in use most of the increased area will be made available largely by cultivating the less favorable lands.

The methods by which we shall increase the yield on lands that are under cultivation will be discussed under the following three headings: (1) Increasing the fertility of the soil, (2) better tillage methods, and (3) the improvement of crops by breeding.

More than half the surface of the earth receives insufficient precipitation for the most favorable growth of crops. The best method of making up this deficiency is through the application of water by irrigation. Unfortunately, the supply of water for this purpose is so limited that only a fraction of the land can be served. In many cases hundreds of thousands of acres of fertile land are found adjacent to a stream that does not contain enough water for a tenth of the land. In a case of this kind it is obvious that the volume of water and not the land area is the factor limiting production.

Here the agronomist's problem lies in the direction of making the limited water produce as much as possible for each acre-foot. He must call in the engineer to help in storing the water of the flood season and making it available when it can be used by crops.

During the early days of irrigation no attempt at storage was made, but as the demand for water increased reservoirs were constructed, often at great cost. With the present structures, probably not more than half of the water in streams of the arid sections is fully used. The remainder runs to waste during the high water or is lost through inadequate systems. One of the first steps that may be taken to increase food production is the construction of additional storage reservoirs and the improvement of canals to eliminate seepage losses.

Even the water that is delivered to the land falls far short of reaching its maximum duty. Many questions affecting the water economy of crops must still be investigated and there must be a wider application of principles of scientific irrigation before the available water will produce maximum crops. The periods when crops are most sensitive to water applications, the varying needs of different crops, the best methods of applying water to each type of soil, and numerous other similar questions must be investigated by the agronomist

and taken fully into account before the arid regions can develop to their full fruition.

It is difficult to give exact figures, but it seems probable that when all possible economies are put into operation the irrigated area of the United States can be enlarged to about four times the present area. It is largely through the agronomist, assisted by the irrigation engineer, that this enlargement can be brought about.

After all possible sources of irrigation water are fully utilized there will be many millions of acres of arid land that can not be served. The only possible chance for producing crops on this land is through the methods of dry-farming, which means that every process is directed toward moisture conservation.

Dry-farming is essentially a branch of agronomy. It is based on a system of tillage that will store in the soil the moisture of one or two years till it is needed by crops. Its success depends on the selection of crops that can endure the rigors of drouth and the breeding of special drouth-resistant varieties.

Probably a larger area can be added to the present productive land by the conquest of drouth than by any other means, but drouth is a relentless enemy of crop production and its successful conquest will call for all the ingenuity of students of soils and crops. Part of the preliminary work has already been done, so that one now sees grain fields where only sagebrush was found a few years ago; but there still remain many difficulties to be overcome before all these vast areas can be made to serve the needs of man.

In humid sections great tracts of land are covered with swamps and produce no important human food. When reclaimed these lands are often exceedingly fertile. The drainage of some of the larger swamps offers rather serious engineering difficulties, but these can in most cases be overcome. The drained swamp with its peaty residue calls for special methods of management and fertilizing, but since agronomists are seeking problems to solve they will not be discouraged by the difficulties encountered in changing a drained swamp into a fertile field.

Somewhat related to the drainage of the swamp comes the reclamation of alkali land since it is largely through drainage that alkali is overcome.

In all arid parts of the world the soil is likely to contain such an excess of soluble salts that crops can not be raised. This condition becomes more acute under irrigation. At the present time in the United States there are millions of acres of land that fail to produce good crops chiefly because they are impregnated with salts. In some of the western states alkali is considered to offer one of the most important and difficult problems affecting agriculture. It will be met by drainage, by special soil treatment, by breeding more resistant crops, and in other ways that agronomists may devise. The problem is now waiting; its solution will mean more food for the world.

Since 1840 when Liebig explained how crops feed great progress has been made in increasing the productivity of the soil. Before the rôle of mineral matter in the growth of plants was understood, all sorts of theories were advanced concerning the food used by plants and as a result many inconsistent practises of fertilizing the soil grew up.

When the real basis of plant nutrition was determined, the beginning of a rational use of fertilizers was at hand. This has resulted in increasing very materially the crop-yields of many soils.

Just how much the acre-yield can be increased is uncertain, but we are sure that by the proper use of fertilizers, by rotation and by better tillage methods the present cultivated area may be made to produce very much more than it is now producing, but the acre-yield can not be increased indefinitely.

Last year in his presidential address before this society, Dr. Lipman ably discussed the nitrogen problem in its relation to increased food production. Each element entering into commercial fertilizers might have been discussed by him with equal interest, so many are the problems surrounding the supplying

of food to plants. Agronomists may be sure that they have not yet found out every method of increasing soil fertility by the use of fertilizers. As the needs for food become more pressing many additional discoveries will result from the researches of students of the soil.

Superior tillage methods, better rotations, and many other improvements in soil management may be expected to contribute to the increasing of the yield of the present cultivated area.

So much has been done during the last few generations to improve crops that we should hesitate before placing any limit on what may be accomplished in this respect in the future. The discovery of some of the fundamental principles of heredity has made progress much more rapid during the last few years than previously when everything was done by the hit-or-miss method.

If no additional land could be added to the cultivated area and if there were no way to increase the fertility of the soil, considerable relief in the food situation might in time be expected to come from crop improvement alone; but when this can be taken in connection with the others, it becomes an especially valuable tool. For example, there are almost unlimited possibilities in developing crops suited to resisting drouth, soil alkali, or other unfavorable conditions in which ordinary crops can not thrive. But here too there is a limit to possible improvements.

From the foregoing, it is evident that the agronomist will be able to render valuable service in insuring an adequate food supply for the increasing population of the world. The question now arises as to what his duty is in the matter. Should he sit idly by as a disinterested spectator and allow things to take their natural course, or should he assume initiative and take an active part in helping to forestall trouble? Will he be one who will give the ounce of prevention, or will he wait till the pound of cure is required? Probably both courses will be taken.

He who is progressive, he who takes his work seriously and is anxious to use his training for the welfare of his fellows, will doubtless take the more positive attitude and devote himself energetically to the solution of the many problems that crowd upon him. Only by profound research can these problems be solved; but he who devotes himself honestly to seeking these solutions will find joy unspeakable and will render a lasting service to mankind.

F. S. Harris

Agricultural Experiment Station,
Logan, Utah

SCIENTIFIC AND INDUSTRIAL RESEARCH IN FRANCE, ITALY, BELGIUM AND JAPAN

The British Committee of the Privy Council for Industrial and Scientific Research in their annual report to Parliament give some account of similar work in other countries. In addition to the activities of the French Department of Scientific, Industrial and Agricultural Research and Inventions, attached to the Ministry of Public Instruction, important steps towards building a great optical industry in France have been taken by the French Ministry of Public Instruction and Commerce, under whose auspices there has been created in Paris an establishment known as L'Institut d'Optique Théorique et Appliquée, with General Bourgeois as president. The institution will include a school of advanced optics, a research and testing laboratory, and a professional school. Measures have been taken to secure a government subvention and an appeal for funds has also been addressed to scientific and industrial organizations. Progress has also been made in engineering research in France. The metallurgical and engineering firms in Grenoble are showing a commendable exhibition of independent initiative and, without waiting for a more or less problematical government grant, have collected funds to found a mechanical and metallurgical laboratory. The laboratory itself is secured and they have appointed a competent local man as its head. There only remains the acquisition of the needful machinery and equipment. This is to be obtained partly by purchase and partly by gifts.

The Italian government has decided to devote special attention to the establishment of industrial experimental stations and the encouragement of technical education. Besides studying new processes and making new applications of old methods, these stations will supply industries with a trained personnel. Five such stations have already been established—two at Milan, for paper and fats respectively; two at Naples, for leather and ceramics; and one at Reggio Calabria, for essential oils and perfumes. It is planned to establish three new stations: one at Rovigno, for the sugar industry; another at Milan, for the development of the refrigerator industry; and a third, probably at Rome, to study the distillation of gases and their by-products and, in general, all processes of combustion. Other stations are under consideration. Laboratory schools are being organized at Turin, Milan, Genoa, Florence, Rome, Naples and Palermo. Provision is also being made for ordinary schools of industry, of which 150 will be royal schools and 400 others subsidized.

The establishment of a national system for encouraging scientific and industrial research in Belgium has been provisionally approved by the minister, but details have not yet been published.

An Institute of Physical and Chemical Research was established in Japan in 1917 with government support of £200,000 over a period of ten years, while a gift of £100,000 has been received from the emperor. The balance of the £800,000, which is required is being collected from private sources. The institution is apparently intended to serve three purposes: (*a*) the prosecution of fundamental researches; (*b*) the conduct of industrial investigations on lines similar to those of the Mellon Institute; and (*c*) the training of research workers who will be elected from among university graduates to research scholarships. Until the laboratories of the institute can be built in Tokyo accommodation is being provided by the universities of Tokyo, Kyoto and Sendai. It is understood further that another Imperial Ordinance has been issued announcing the establishment of a new Bureau in the Department of Agriculture and Commerce for the purposes of industrial experiment. This bureau will control work in connection with experiments, analysis, appraisal and instruction. There will be two experimental stations; one in the Tokyo district and one in the Osaka district.

SCIENTIFIC EVENTS

AERONAUTIC SECTION OF THE AMERICAN SOCIETY OF ENGINEERS

IN the field of aviation a good deal of cooperative engineering work has been done, standards have been established, details of construction perfected, interchangeability secured. Nevertheless there still exists the real opportunity for promoting in a large way the broad engineering development having to do with the future of aerial navigation regarded as an essentially international science, art and business. To this end the members of The American Society of Mechanical Engineers interested in aeronautics have organized themselves into a professional section of this subject.

Howard E. Coffin, Jesse G. Vincent, Orville Wright, C. F. Kettering, Elmer A. Sperry, James Hartness, John R. Cautley, Lionel S. Marks, Miller R. Hutchison, Charles E. Lucke and Joseph A. Steinmetz, all prominent in the aeronautic field in the war, are among those who have registered in the section.

As chairman of the advisory committee on aeronautics under the Council of National Defense, Mr. Coffin sent the first American delegation to the London Conference on Aircraft in the spring of 1918. In the full realization of the possibilities of future commercial as well as military and naval development, the Peace Conference created a commission for drafting an International Aircraft Convention. Benedict Crowell, assistant secretary of war, and as chairman of the American Aviation Mission visiting Europe in 1919, urged the adoption of a definite engineering basis to secure the future of air navigation and to guide bodies entrusted with the formulation of laws. Herbert Hoover, in his recent address before the American Institute

of Mining Engineers, stressed the limitations of individual initiative and development, and the crying need for definite, comprehensive programs for the solution of our great engineering problems. These things have influenced the A. S. M. E. to take the step of organizing this section with the hope that, through cooperation with all the agencies interested in and working in this field, general good will be brought to the whole industry.

COMMITTEE ON PROBLEMS OF ELECTRICAL INSULATION

THE National Research Council has planned an investigation of the principles of insulation, a matter which is of vital importance to the electrical trade and to its consumers. A meeting of the council's insulation committee was held recently at the laboratories of the Western Electric Company at 463 West Street, New York City. It was attended by a number of engineers and physicists, the chief engineer of the Western Electric Company, Dr. F. B. Jewett, who is chairman of the committee, presiding.

A preliminary meeting of the committee was held a year ago, but at that time no definite plans were formulated. At this meeting it was decided that the first step is the gathering together of all the published and known scientific material relating to insulation. This is a large undertaking and the committee decided that a permanent salaried secretary should be engaged to carry on the compilation of the material which has already been published and to maintain continuity in the records and activities of the committee. The committee also decided that it would attack the technical problems by providing some research men in the universities with funds and materials supplied by the industries under the guidance of the National Research Council. The scarcity of skilled and trained research men, who are capable of attacking insulation problems is a matter of much concern to the insulation committee. An effort will be made to discover among the postgraduate students and the faculties of the universities men who are able to do this work.

The committee consists of thirty-seven representatives from the electrical industries, the national engineering societies, the national scientific societies, the national manufacturing organizations and the universities and colleges of the country. Among those who attended the meeting were: Mr. C. E. Skinner, Westinghouse Electric & Manufacturing Co., Dr. Irving Langmuir, General Electric Co., Mr. Percy H. Thomas, Consulting Electrical Engineer, New York, Mr. William A. Del Mar, New York, D. W. Roper, Commonwealth Edison Co., Chicago, Ill., Dr. Clayton H. Sharp, Electrical Testing Laboratories, New York, Professor John Johnston, Yale University, Professor Frederick Bedell, Cornell University, Professor A. E. Kennelly, Massachusetts Institute of Technology, Professor K. T. Compton, Princeton University, Edward D. Adams, Engineering Foundation, New York, Dr. Carl Hering, consulting engineer, Philadelphia, Pa., John M. Weiss, The Barrett Company, New York, Dr. Richard C. Tolman, Chemical Division, National Research Council, Washington, D. C., and Dr. F. B. Silsbee, Bureau of Standards, Washington, D. C.

THE ORIENTAL INSTITUTE OF THE UNIVERSITY OF CHICAGO

DIRECTOR JAMES HENRY BREASTED, of the Oriental Institute of the University of Chicago, who recently returned from an archeological survey of the Near East, reports that the remarkable collections which the expedition was able to purchase have arrived at the Haskell Oriental Museum and are now unpacked preparatory to their public exhibition.

Among these is a complete group of twenty-five painted limestone mortuary statuettes from Egypt, representing the deceased and the members of his family engaged in all sorts of household activities. They date from the Old Kingdom (3,000 to 2,500 B.C.) and form the most extensive group of such figures ever discovered in one tomb. In addition to a group of royal seal cylinders and a group of some

seventy-five alabaster vases, is a collection of about a hundred and fifty predynastic and early dynastic hard stone vases, one being inscribed with the name of the first Pharaoh (3,400 B.C.).

Among other acquisitions is a group of about one hundred bronzes, including some sixty-five statuettes and a series of fine battle-axes which form the finest collection of bronzes ever brought from the Near East to America. A beautifully written papyrus roll of the Book of the Dead, probably of the seventh or sixth century B.C., is far the best manuscript of this book as yet brought to America; and the purchase of the Timins Collection of stone weapons and implements gives to the university the finest collection of Egyptian Stone Age industries in this country.

From Asia comes a series of two hundred and fifty-eight cuneiform tablets containing business records and a copy of the Royal Annals of Sennacherib. The latter document is in the form of a six-sided prism of buff-colored terra cotta in perfect preservation. It records the great campaigns of the famous Assyrian emperor, including the western expedition against Jerusalem in which he lost a large part of his army. No such monument as this has yet been acquired by American museums, and it will be of primary value to students and of unique interest to the public. Of other cuneiform documents the purchases total a thousand tablets, some of special literary and religious interest.

THE NEWS SERVICE OF THE AMERICAN CHEMICAL SOCIETY

IN his report the technical director of the A. C. S. News Service says:

The reports from the clipping agencies indicate that the publicity given to the Chicago meeting was exceptionally large. Whether it will equal in volume or surpass that received from the St. Louis meeting can not be ascertained until the full returns are analyzed.

As Chicago is one of the world's greatest news distributing centers, the wires of the Associated Press, the United Press and similar organizations sent out many dispatches to the newspapers of the country, as is shown by the sheaves of clippings now being garnered by the A. C. S. News Service. The admirable dispatch summarizing the work of the meeting, written by Mr. Richard D. Jones, of the United Press, had an especially wide distribution. The daily papers throughout Illinois, Indiana and various parts of the middle west carried unusually full accounts.

The sixtieth meeting was held in the midst of a political campaign and in a city, the press of which happened to be giving more than usual attention to local affairs. The Chicago newspapers, however, printed about ten columns concerning the sessions. The most attention was given by the *Journal*, and the other leading Chicago papers are herewith given according to the space allotted by each: *Tribune*, *American*, *Daily News*, *Post*, *Herald-Examiner*.

Extensive dispatches were printed in the eastern papers and some of them appeared in prominent positions. The subjects which seem the most popular to date, as far as lay journalism is concerned, are flavoring extracts without alcohol, the resolution urging Congress to pass dye legislation, hydrolyzed sawdust as cattle food, all news relating to fuel and news print, and the announcement that America now makes 800 rare chemicals, this last being featured on the front page of the *New York Times*.

More trade and technical publications sent representatives than ever before in the history of the Society, because of the fact that so many periodicals of this class are either published in Chicago or have branch offices there.

The A. C. S. News Service wishes to acknowledge the very efficient help of the Chicago Section's Publicity Committee, of which Mr. Chester H. Jones is the chairman.

GRANTS FOR RESEARCH OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE attention of investigators is called to the fact that the committee on grants of the association will soon have at its disposal some four thousand dollars for distribution in aid of research. Amounts up to about five hundred dollars will thus be available for work in each of the various sciences: mathematics, physics, chemistry, astronomy, geology, zoology, botany, anthropology, psychology, social and economic sciences, and education. The rules governing the assignment of grants were published in SCIENCE for January 23, 1920.

Applications for grants should be made not later than December 1, 1920, to any member of the committee, the personnel of which is as follows: Henry Crew, chairman; W. B. Cannon, R. T. Chamberlin, G. N. Lewis, George T. Moore, G. H. Parker, Joel Stebbins and Robert M. Yerkes. The awards will be announced soon after January 1, 1921.

JOEL STEBBINS,
Secretary Committee on Grants

URBANA, ILL.

SCIENTIFIC NOTES AND NEWS

THE International Congress of Mathematicians at the Strasbourg meeting accepted the invitation presented by Professor Leonard E. Dickson to hold the next congress in New York in 1924.

AT the International Congress of Physiologists, held in Paris, it was resolved, on the invitation of Sir E. Sharpey Schafer, to hold the next meeting in Edinburgh in 1923.

PROFESSOR STEPHEN MOULTON BABCOCK, of the University of Wisconsin, inventor of the Babcock test for determining the amount of butter fat in milk, reached his seventy-seventh birthday on October 22, and in honor of the event and of his work a university convocation was held. Professor Babcock is engaged in active work in his laboratory.

DR. EMILE ROUX, director of the Pasteur Institute, Paris, has been awarded the Grand Cross of the Legion of Honor, with the citation: "Principal collaborator and disciple of Pasteur, throughout an admirable life of simplicity, modesty, labor and devotion he has continued the great work of his master, notably by his researches on diphtheria; by his discovery of antidiphtheritic serum he has conquered this formidable disease and has saved a great number of lives. President of the Conseil supérieur d'hygiène, director of the Pasteur Institute for which he has gained universal renown. A noble and great figure in the world of science."

THE Rumford Committee of the American Academy of Arts and Sciences has made the following appropriations in aid of research: To Professor W. W. Campbell, of Lick Observatory, $360 for the purchase of a special photographic lens; to Professor H. L. Howes, of the New Hampshire State College, $90 in aid of his researches on luminescence.

DR. F. HASTINGS SMYTH, formerly captain in the Chemical Warfare Service, has joined the staff of the Geophysical Laboratory, Carnegie Institution of Washington.

MR. L. E. JACKSON has resigned as chemist and chemical engineer with the Empire Gas & Fuel Co., Bartlesville, Okla., to accept a fellowship at the Mellon Institute.

PROFESSOR MARK ALFRED CARLETON, formerly cerealist of the United States Department of Agriculture, and recently plant pathologist of the United States Grain Corporation, is at present engaged as plant pathologist for the United Fruit Company, with headquarters at Bocas del Toro, Panama. At the last meeting of the American Society of Agronomy Professor Carleton was elected the first honorary life member of that society.

DR. L. O. GRONDAHL, until recently associate professor of physics at Carnegie Institute of Technology, Pittsburgh, Pa., has resigned to accept the position of director of research with the Union Switch and Signal Company, Swissvale, Pa.

D. HARRISON E. PATTEN, for several years research chemist with the Bureau of Chemistry of the Department of Agriculture, Washington, D. C., has accepted the position of chief chemist of the phosphate plant of the Provident Chemical Works, St. Louis, Mo.

DR. FREDERICK E. BREITHUT has entered the employ of the Calco Chemical Company, Boundbrook, New Jersey.

GEORGE P. GRAY has resigned his position as assistant professor of entomology and chemist, insecticide laboratory, at the University of California, to become chief of the Division of Chemistry of the newly established Department of Agriculture of the State of California, Sacramento, Calif.

MR. SAMUEL H. SIMPSON has resigned his position in the physical chemistry section of

the Bureau of Standards, Washington, D. C., and is now in the sales division of the Edison Electric Appliance Co., Chicago, Ill.

Samuel J. Plimpton has returned from a year's leave of absence in Europe and has taken up his work as professor of physics at Worcester Polytechnic Institute.

Mr. W. P. Woodring and a party from the U. S. Geological Survey have left for Haiti to conduct a reconnaissance geologic examination of the Republic of Haiti at the request of that government.

Dr. and Mrs. Casey A. Wood, of Chicago, have gone to British Guiana for the winter. Dr. Wood plans to conduct some researches on the comparative anatomy of the eye with special reference to birds.

Clifford S. Leonard, who received the degree of Ph.D. from the University of Wisconsin in June, has accepted one of the traveling fellowships of the American Scandinavian Foundation, and has sailed for Sweden. He will study chemistry and pharmacology at the Karolin Institute in Stockholm.

At the 149th meeting of the Washington Academy of Sciences on October 23, Dr. E. B. Rosa, chief physicist of the Bureau of Standards, gave an address on "A reorganized civil service." Those expected to take part in the discussion were Colonel W. B. Greeley, chief forester, Department of Agriculture and president of the Federal Club; Mr. Paul F. Myers, deputy commissioner of internal revenue; Dr. George Otis Smith, director of the Geological Survey; Dr. F. G. Cottrell, director of the Bureau of Mines; Dr. P. P. Claxton, commissioner of education; Mr. O. C. Merrill, executive secretary, Federal Power Commission; Mr. Martin A. Morrison, president, Civil Service Commission; Mr. Lewis Meriam, assistant director, Institute for Government Research.

The meeting of the New York Section of the American Chemical Society on October 22 was in the nature of a welcome to Dr. W. A. Noyes, professor of chemistry in the University of Illinois. The following addresses were made: "The foundation for chemical development," by Professor W. A. Noyes, and "The National Research Council and chemical development," by Harrison E. Howe.

Dr. Colin G. Fink, of New York, recently addressed the Rochester Section of the American Chemical Society on "Modern developments in metallurgical research."

The inaugural lecture of Professor Maximilian Toch, recently appointed adjunct professor of industrial chemistry at Cooper Union, was given on October on the subject "The chemistry of artistic painting."

Professor Jules Bordet, director of the Pasteur Institute of Brussels, delivered the second Harvey Society lecture at the New York Academy of Medicine on October 30. His subject was "Coagulation of the blood."

On the evening of November 12 a service in memory of the late Dr. Eric Doolittle, professor of astronomy, will be held in the auditorium of Houston Hall, University of Pennsylvania. Addresses will be made by Professor Frank Schlesinger, of the Yale Observatory, and president of the American Astronomical Society, the Rev. Robert Norwood and Provost Edgar F. Smith.

Alfred E. Fletcher, known for his work in industrial chemistry and especially in the English alkali industry, has died at the age of ninety-four years.

A site for the new building in Washington which is to serve as a home for the National Academy of Sciences and the National Research Council has recently been obtained. It comprises the entire block bounded by B and C Streets and Twenty-first and Twenty-second Streets. Northwest, and faces the Lincoln Memorial in Potomac Park. The academy and council have been enabled to secure this site, costing about $200,000, through the generosity of the following friends and supporters: Thomas D. Jones, Harold F. McCormick, Julius Rosenwald, and Charles H. Swift, Chicago; Charles F. Brush, George W. Crile, John L. Severance and Ambrose Swasey, Cleveland; Edward Dean Adams, Mrs. E. H. Harriman, and the Com-

monwealth Fund, New York City; George Eastman and Adolph Lomb, Rochester; E. A. Deeds and Charles F. Kettering, Dayton; Henry Ford, Detroit; Arthur H. Fleming, Pasadena; A. W. Mellon, Pittsburgh; Pierre S. duPont, Wilmington; Raphael Pumpelly, Newport; Mr. and Mrs. H. E. Huntington, Los Angeles; Corning Glass Works Corning, New York. Funds for the erection of the building have been provided by the Carnegie Corporation of New York.

The American Chemical Society has increased the annual dues from ten to fifteen dollars. The finance committee reports that for the present year the society will just about keep inside its budget as a whole, excepting for the matter of printing. In the item of printing, all the journals are necessarily running beyond their budgets due to the increases in costs of paper and printing that have already accrued. If the journals print the same amount of material for the next four months that they have been averaging, and the cost of paper, printing, etc., are the same as it has been for the last eight months, then the *Journal of the American Chemical Society* will exceed its budget by nearly $10,000; *Chemical Abstracts* will exceed its budget by nearly $8,000; and the *Journal of Industrial Chemistry* will exceed its budget by nearly $3,000.

The Paris correspondent of the *Journal* of the American Medical Association writes that the president of France having decreed that the public welfare demands the creation of certain institutes, notably an institute of hygiene, in affiliation with the University of Paris, on grounds accruing from liquidation of the congregation of Jesuits, the minister of public instruction has been authorized to acquire this property by expropriation in the name of the state.

The London *Times* reports that in a discussion on the Einstein theory of relativity at Bad Nauheim on September 23 Professor Grebe, of Bonn, declared that the third test had been passed. According to Professor Einstein, there should be a "shift" towards the red of the lines in the solar spectrum of from 0.62 to 0.63. The absorption bands of nitrogen had been selected and compared with a spectrum of a carbon arc. More than 20 measurements of each line had been made. There were differences in the "shift" of individual lines, but when allowance had been made for disturbing factors the "shift" was found to be about 0.66—a close agreement with prediction.

For many years Dr. Joseph Lane Hancock, of Chicago, has been recognized as an authority on the Tettiginæ or Grouse-locusts, and in that time has assembled probably the largest collection of these insects extant, numbering over five thousand specimens. Due to added medical responsibilities, Dr. Hancock has now closed his Orthopterological studies and his collection has been added to the Hebard Collection of Orthoptera at the Academy of Natural Sciences of Philadelphia. In order to continue the work in this group, Dr. Hancock's correspondents and collectors are invited to communicate with Mr. Morgan Hebard, Academy of Natural Sciences, 1900 Race St., Philadelphia, Pa. Every effort will be made to continue the growth of the collection of Tettiginæ as well as carrying on the systematic studies.

We learn from the *British Medical Journal* that last spring a beginning was made at University College, London, with the foundation of a school of the history of science. Dr. A. Wolf, reader in logic, then made a first attempt at some organized presentation of the history of scientific ideas by arranging for a series of lectures; the course was inaugurated by Dr. Charles Singer last May in a lecture in which Greek science and modern science were compared and contrasted. This autumn much fuller arrangements have been made, and a series of courses of lectures will be given. The field to be covered is wide, ranging from Egyptian science to the most important developments of physical science in the nineteenth century, and from biology to mathematics in the eighteenth century. An introductory public lecture will be given on Thursday, October 7 by Professor Sir William

H. Bragg, F.R.S., and on October 13 Dr. Wolf will begin an introductory course of lectures on general history and development of science; this course will be illustrated by lantern slides, and visits will be made to museums. On October 12 at 5.15 P.M., Dr. Charles Singer will begin a course of twelve lectures on the history of the biological and medical sciences from early times till the eighteenth century. Dr. Singer's intention is to make his course a history of medical science, for down to a certain date the biological sciences are inseparable from medicine; he will omit all discussion of social phenomena and personalities. The history of the biological sciences since the eighteenth century will be dealt with by Professor J. B. Hill, F.R.S., in a course of six lectures, beginning next May.

THE Carnegie Institute of Technology of Pittsburgh is completing the most elaborate coal mining laboratory in America. The laboratory, which will be finished by the opening of the fall term, is located beneath the building of the division of science and engineering of the institute. The equipment comprises a full-sized coal mine—a model mine, except that it yields no coal—a mine locomotive and a full set of coal and metal mine machinery, that has been furnished by manufacturers. In addition to the mining laboratories proper there will be a completely equipped ore-dressing and coal-washing plant. It is purposed to extend the mine, during the practise work of the students, along such a plan that it can be utilized for carrying some of the steam and water pipes of the institute.

UNIVERSITY AND EDUCATIONAL NEWS

FROM October 7 through the 17, the University of Buffalo conducted an intensive campaign among the citizens of the city for a fund of five million dollars, to be used partly for endowment and partly for additional buildings. The "drive" was a complete success, and a total of about $5,500,000 was subscribed. The campaign was conducted in the absence of an educational head, Charles P. Norton, having resigned as chancellor of the university early in the summer. He was elected vice-chancellor in 1905, and chancellor in 1909. In his administration a new site for the university was secured, and the new buildings will be erected on a campus of 150 acres at the city line. A committee of the council is charged with the duty of securing a new chancellor.

DR. WALTER T. TAGGART, for many years professor of organic chemistry at the University of Pennsylvania, has been elected to succeed Dr. Edgar Fahs Smith as Blanchard professor of chemistry at that institution. Dr. Smith resigned as provost and professor of chemistry last June. Professor Taggart is now the head of the chemical department of the university.

DR. EDWARD WYLLYS TAYLOR, professor of neurology in the Harvard Medical School, has been appointed to the James Jackson Putnam professorship.

MISS GLADYS BRYANT (Radcliffe '17), has become demonstrator in general physiology at Rutgers College.

THE department of chemistry of Cooper Union announces the appointment to its staff of William N. Pritchard, formerly with the Calco Company, Boundbrook, N. J., and of Harold Hurst, formerly with the Le Doux Company.

DR. ERNEST ANDERSON, for the past three years professor of Agricultural chemistry in Transvaal University College, Pretoria, has been appointed professor of general chemistry in the University of Nebraska.

J. B. FERGUSON has left the research laboratories of the Western Electric Company, of New York City, to accept an appointment as associate professor of research chemistry at the University of Toronto.

PROFESSOR ALBERT EINSTEIN, of the University of Berlin, has accepted the chair of science in the University of Leiden. He will divide his time between the two institutions.

DISCUSSION AND CORRESPONDENCE

PROFESSOR FIELD'S USE OF THE TERM FOSSIL

In examining copies of Science which accumulated during the vacation just closed, a contribution on the "Use of the Term Fossil" in the number of date June 25 has attracted my attention and challenges criticism.

The definition proposed by Professor Field in this contribution is faulty in that it errs in the time concept. He has committed the popular error of considering "historic" synonymous with the present geological epoch. The remains of an animal or plant may antedate human history (be prehistoric) by many thousands of years without belonging to a past geological epoch.

In constructing a definition of the term fossil, it is difficult to improve upon the essential ideas connoted by the term as used by Dr. Karl Von Zittel in his "Palaeozoologie." According to this authority fossils need not be mineralized, nor the remains of extinct organisms, but must possess a certain antiquity—they must have come down to us from a geological age earlier than the present.

We would propose then as a concise definition of fossil, "Any trace of an organism that lived in a past geological age."

While agreeing that accuracy in scientific definition is an object worth striving to attain, we can not concur with Professor Field in objecting to a use of certain scientific terms in a derived sense—commonly figurative. Language is being constantly enriched by such usage.

The expression "fossil botanist" may be criticized as objectional, because ambiguous, but "fossil ripple marks," "fossil suncracks," "fossil flood plains" (Shimer) are illuminating and apt and are valued contributions to geological phraseology. It is futile to inveigh against such usage or against "literary persons" for coining the terms "fossil poetry" and "fossil statesman." Rather should we rejoice in this evidence that our science is not altogether out of touch with modern life. Whether we approve or not, such expressions have come to stay. Not only new words, but old words with a new meaning content are being constantly introduced into a growing language. Words simply will not stay tied, but as Archbishop Trench put it are, as regards their meanings, "constantly drifting from their moorings." The term fossil, itself, is an illustration in point; also the names of certain fossils, as *belemnite*, *ammonite* and *nummulite*, which embody original erroneous conceptions as to their nature.

As an illustration of a fossil that as the result of refusing to be straight jacketed has made an important contribution to English we have *mammoth*, from the Tartar word *maimon*. In the space of about one hundred years this word has given us in its adjective use a synonym for *huge* so thoroughly incorporated into our speech that few people recognize its exotic character. It may be of interest to some to learn that the first recorded use of the name of this animal in an adjective sense was in Kentucky. John Filson in describing Big Bone Lick in his History of Kentucky, written in 1784, referred to the animal as *maimon*. Within three years, however, we find Thomas Jefferson and others, also in describing Big Bone Lick, calling the animal *mammoth*. Within twenty-five years from this time we find the word beginning to be used as an adjective in the sense of *very large*. The earliest recorded instance of its use in this sense in in 1812, when in a deed it was applied to a very large saltpeter cave in what is now Edmonson but was then Warren county, Kentucky. That this use of the word had not spread to England by 1818 is evidenced by a passage in the letters of James Flint, who writing to England at that date and referring to this large cave in Kentucky remarks that "they call it *Mammoth Cave*, but why I do not know, for there are no mammoth bones found there." Evidently at that time the use of the word in the sense of *large* was too much of an Americanism to be comprehended by this Englishman.

Arthur M. Miller

University of Kentucky,

GALILEO'S EXPERIMENTS FROM THE TOWER OF PISA

Mr. Partridge's declaration (Science, Sept. 17, 1920) that "we do not know exactly what experiment Galileo performed" from the leaning tower of Pisa appears to me too sweeping. In the first place, Vincenzio Viviani, in his life of Galileo, speaks of "repeated experiments" not of one "experiment." A series of trials is what one would expect. It is highly improbable that Galileo would perform an experiment before a university assembly which he had not previously tried out. The historic data are as follows: (1) Viviani tells us that Galileo at the leaning tower of Pisa used "different weights"; (2) Galileo in his "De Motu" (probably written before he left Pisa) speaks of dropping wood and lead from a high tower; (3) In his "Dialogues concerning two new Sciences,"[1] Galileo lets Sagredo say:

> But I, Simplicio, who have made the test can assure you that a cannon ball weighing one or two hundred pounds, or even more, will not reach the ground by as much as a span ahead of a musket ball weighing only half a pound, provided both are dropped from a height of 200 cubits.

Later Salviati says that "the larger (iron ball) outstrips the smaller by two finger-breadths." On the remark of Simplicio that perhaps the result would be different if the fall took place "from some thousands of cubits," Salviati replies:

> If this were what Aristotle meant you would burden him with another error . . . since there is no such sheer height available on earth.

It is true that in the above "Dialogue" Galileo does not give the place of experimentation and does not mention the leaning tower. But what other locality in Pisa would have been as favorable? From the above data it follows that Galileo dropped different weights of a variety of materials and noticed which of them fell faster.

[1] Translation by H. Crew and A. De Salvio, New York, 1914, pp. 62, 65, "First Day."

That Viviani was in a position to speak with authority follows from the fact that soon after Galileo had published his "Dialogue concerning two New Sciences," 1638, Viviani became his pupil and was in close contact with him for three years, receiving instruction which began with the theory of moving bodies. Favaro[2] advances evidence which shows that Galileo and Viviani became quite intimate, Viviani admiring the old sage and Galileo treating the young man as if a son.

Florian Cajori
University of California

[2] Antonio Favaro, "Amici e Corrispondenti di Galileo Galilei. XXIX. Vincenzio Viviani." Venezia, pp. 8–19.

JONATHAN EDWARDS ON MULTIDIMENSIONAL SPACE AND THE MECHANISTIC CONCEPTION OF LIFE

If the Einstein conception of space is multidimensional and inclusive of the essential conceptions of time and place, then Jonathan Edwards, whom John Fiske characterized as the greatest mind of the Western World, may prove to be the spiritual father of this geometry. Thus wrote Jonathan Edwards:[1]

> Supposing that there are two Particles or Atoms of Matter perfectly equal and alike, which God has placed in different Parts of the Creation. . . . If they are perfectly equal and alike *in themselves*, then they can be distinguished or be distinct only in those Things which are called *Circumstances;* as Place, Time, Rest, Motion, or some other present or past Circumstances or Relations. . . . If God makes two bodies *in themselves* every Way equal and alike, and agreeing perfectly in all other Circumstances and Relations but only *their Place*. then in this only is there any Distinction and Duplicity. The Figure is the same, the Measure is the same, the Solidity and Resistance are the same, and every Thing the same, but only the Place. . . . The Difference of Place, in this (the former) Case,

[1] "A Careful and Strict Enquiry into the modern prevailing Notions of that Freedom of the Will which is supposed to be essential to Moral Agency, Vertue and Vice, Reward and Punishment, Praise and Blame," 1754, p. 243; "Of God's Placing differently Similar Particles."

proves no more than the Difference of Time does in an (the) other.

Edwards, about to become president of the College of New Jersey, and at this date writing as a missionary to the Indians; "Pastor of the Church in Stockbridge," has in the same chapter, these Princetonian thoughts on evolution suggested by Sir Isaac Newton's "Laws of Motion & Gravitation."

Let us suppose two Bodies moving the same Way, in strait Lines, perfectly parallel one to another; but to be diverted from this Parallel Course, and drawn one from another, as much as might be by the Attraction of an Atom, at the Distance of one of the furthest of the fix'd Stars from the Earth; these Bodies being turned out of the Lines of their parallel Motion, will, by Degrees, get further and further distant, one from the other; and tho' the Distance may be imperceptible for a long Time, yet at Length it may become very great. So the Revolution of a Planet round the Sun being retarded or accelerated, and the Orbit of it's Revolution made greater or less, and more or less elliptical, and so it's Periodical Time longer or shorter, no more than may be by the Influence of the least Atom, might in Length of Time perform a whole Revolution sooner or later than otherwise it would have done; which might make a vast Alteration with Regard to Millions of important Events. So the Influence of the least Particle may, for ought we know, have such Effect on something in the Constitution of some human Body, as to cause another Thought to arise in the Mind at a certain Time, than otherwise would have been; which in Length of Time (yea, and that not very great) might occasion a vast Alteration thro' the whole World of Mankind.

Thus the describer of the Ballooning Spiders. Einstein, Conklin; Behold your King!

J. M. C.

ALBANY, N. Y.

SCIENTIFIC BOOKS

Heredity and Evolution in Plants. By C. STUART GAGER. Philadelphia, 1920. P. Blakiston's Son and Co. Pp. xiii + 265. Figs. 113.

This very readable book is in part a reprint of certain sections of the author's "Fundamentals of Botany" but with considerable new matter added and much of the old recast. An account of the life history of the fern lays the foundation for a discussion of cell structure and the fundamentals of cell behavior in reproduction and at the critical periods of fertilization and reduction. Then comes a chapter on heredity followed by a consideration of results from experimental studies of Mendel, Johannsen, and others.

Chapters entitled "Evolution," "Darwinism" and "Experimental Evolution" give the views of Lamarck, Darwin, Wallace and de Vries. The statement of the mutation theory of de Vries is excellent but there is nothing to indicate to the reader how difficult it is to distinguish between mutations and the results of segregation in impure species the breeding behavior of which is complicated by the presence of lethal factors. There is no reference to the remarkable genetical complications which are known for *Œnothera* material rendering it among the most interesting and puzzling under investigation although correspondingly less favorable for the demonstration of mutations.

The latter half of the book considers the evolutionary history of the plant kingdom from evidence supplied by comparative morphology and life histories, geographical distribution, and paleobotany. In this section is brought together much scattered information which together with the discussion is likely to prove of particular interest to the general reader not familiar with geographical botany and with the striking contributions of recent years from studies of ancient plant remains.

BRADLEY M. DAVIS

UNIVERSITY OF MICHIGAN

NOTES ON CLIMATOLOGY AND METEOROLOGY

AEROLOGICAL WORK IN THE UNITED STATES

METEOROLOGY, until recent years, has been largely a two-dimensional science. Indeed, so strongly has the conception become rooted in the minds of meteorologists, that now, when

the data from soundings of the upper air are becoming available in fairly large quantity, it is necessary to engage in a careful study to determine the most profitable and intelligent way to use them. In recent years, aerological work has been steadily advancing to its place in the forefront of meteorological endeavor, and to-day most national meteorological services have established, or are establishing, aerological divisions. In other words, it is realized that probably the real controls of surface weather lie somewhere in the upper air.

The first aerological work in the United States was done at Blue Hill Observatory, near Boston, under the directorship of Rotch. In 1907, the United States Weather Bureau established a station at Mt. Weather, Virginia. That station, which has a record of frequent kite flights and aerial soundings by captive balloons, was discontinued after seven years. Other stations have been established, however, at Drexel, Nebraska; Ellendale, North Dakota; Broken Arrow, Oklahoma; Groesbeck, Texas; Royal Center, Indiana; and Leesburg, Georgia. The data from the many thousands of kite flights made at these stations have been and are being published in the *Supplements* of the *Monthly Weather Review*. These data include temperatures, pressures, moisture content, wind speed and direction, at various levels in the free-air. It should be said, however, that one of the inherent features of kite data is that they represent conditions in moderate winds only, since kites can not be flown in very light or very strong winds.

A convenient summary of the work of the Drexel Aerological Station was recently published in the *Monthly Weather Review*.[1] The purpose of the summary, says Mr. Gregg, is "to present in brief and convenient form for the information and use of artillery and aviation services the results of free-air observations that have been secured by means of kites at Drexel, Nebraska." There are many tables and charts. The values obtained are the means of 1,074 kite flights. The author, in his synopsis, says:

> A discussion of the reliability of the data indicates that instrumental and observational errors have been largely eliminated; that the monthly distribution is good; that the diurnal distribution is less satisfactory, but probably fairly representative, at any rate for all levels a short distance above the surface; but that, owing to the shortness of the period under consideration and its wide departures at times from normal conditions, some of the monthly means can not be considered as normal values. These irregularities largely disappear, however, in the seasonal and annual averages; and the latter, especially, may be accepted as closely approximating true conditions.

Now that a number of years' data have accumulated, what are the benefits which may accrue from a study of them? Among others, there are two problems, which may be considered: one is of immediate importance, the other is an old one, long recognized, but attacked only at rare intervals, and with varying success. The first concerns itself with forecasting for aviation, the second with the reduction of pressure in the Plateau region of western United States. They represent only two of the many problems, the solution of which aerological data may aid.

A paper on the question of making pressure maps for stated levels in the free-air as aids in forecasting winds aloft for the use of aviation and as a suggested panacea for the long-recognized reduction difficulties in western United States, has just appeared.[2] The central idea about which the work is built is that the Laplacian hypsometric formula requires a value to be substituted for the term representing the mean temperature of the air column which exactly satisfies its definition. Reductions to sea-level obviously can not do

1 Gregg, Willis Ray, "Average free-air conditions as observed by means of kites at Drexel Aerological Station, Nebr., during the period November, 1915 to December, 1918, inclusive," *Monthly Weather Review*, January, 1920, pp. 1–11. Reprints may be obtained upon application to the Chief of the Weather Bureau, Washington, D. C.

2 Meisinger, C. LeRoy, "Preliminary Steps in the Making of Free-air Pressure and Wind Charts," *Monthly Weather Review*, May, 1920, pp. 251–263.

this because sea-level lies, in practically all cases, below the station level, hence *there is no air column*. The temperature argument at present employed in reducing to sea-level is the mean of the current surface temperature and the temperature as recorded at the observation twelve hours before, and this *happens* to do very well except in those regions where the so-called air column is quite long. The obvious solution of this difficulty is the measurement of the mean temperature of a *real* air-column above the station.

The work referred to above embraces over 3,000 kite flights made at Mt. Weather, Drexel, and Ellendale. The mean temperature between the surface and the levels of 1 and 2 kilometers above sea-level have been classified by surface wind directions and by months. These temperatures are not used as they stand, but, to render them comparable, they are each subtracted from the surface temperature, thus giving a series of values showing the difference between the mean temperature of the air column and the surface temperature. After doing this for the three stations it was found that they all show certain characteristics. For example, to quote from the synopsis of the paper:

> It was found, in general, that in winter, with southerly winds, the air column has a higher mean temperature than the surface; that in summer, with northerly winds, the air column has a temperature below that of the surface. These effects are due, primarily, to the seasonal variation of surface temperature. The amplitude of the values was much greater at the inland stations, Ellendale and Drexel, than at Mount Weather, near the coast. Aside from the geographical contrasts, the difference between the surface temperature and that of the air column to a height of 1 or 2 kilometers depends, so far as the surface factor is concerned, mostly on the season; and, so far as the temperatures aloft are involved, upon the wind direction.

A statistical study of the data reveals the fact that pressure can be reduced from the station to levels one or two kilometers above sea-level with a very satisfactory degree of accuracy. Indeed, in reducing through an air-column 2,000 meters in length, it is found that the probable error of the temperature determination is so small that, when translated into terms of pressure at the upper level, it amounts to only ± 1.3 mb. For the 1 kilometer level it is only $\pm 0{:}5$ mb.[3]

When this study is carried further, as is contemplated, all kite stations will be discussed and an endeavor will be made to work the scheme out with such simplicity that the observer can know the mean temperature of the air column from the direction of the surface wind, substitute this in his reduction formula and obtain the pressure at the upper level.

The advantages of such charts must be proved by experience. But it is obvious that if they can be constructed accurately, they must yield a far better basis for forecasting winds aloft than do the present sea-level maps —for it is in the very nature of the gradient, or geostrophic, wind to obey the pressure distribution *at its level*. The gradients on the sea-level map can not be of great assistance, even to the height of 500 meters above sea-level. If such charts are thus productive of greater accuracy in forecasting winds in the upper air, their existence is quite justified; and if, in the Plateau of western United States, we can free our weather maps of the barometric apparitions which haunt them at present, it is possible that these charts of the upper air may be of direct value in general forecasting.

The third paper to be mentioned is a short note by Mr. Gregg[4] on the program of aerological work instituted by the Weather Bureau for the hurricane season. It is believed that there is a relation between the velocity of motion of tropical hurricanes and the winds aloft. To collect data, pilot balloon stations have been placed at San Juan, P. R., and Key West, Fla. These, cooperating with the regular permanent pilot balloon stations in

[3] 1,000 millibars is equivalent to a pressure indicated by 750.1 millimeters, or 29.53 inches, of mercury.

[4] Gregg, W. R., "Aerological Observations in the West Indies," *Monthly Weather Review*, May, 1920, p. 264.

the Gulf States and the two Navy stations at Colon and Santo Domingo, will form a "network which, it is believed, will furnish information of great value in the study of these destructive storms and in forecasting their direction and rate of movement." Whether or not hurricanes occur, observations will be made twice daily and the data on trades, antitrades, etc., will well repay the effort, for very little is known of the winds aloft in those regions. If funds permit, this program will be extended during the next several years.

Not only is it essential that means be provided for the extension of pilot balloon work in the West Indies, but also in the United States proper. At present there are about two dozen stations sending daily reports of free-air wind conditions to the forecast centers of the Weather Bureau. This information forms the basis of forecasts that are issued for the information of aviators in the Aerial Mail Service and the Army and Navy Air Services. At least fifty, and preferably a hundred, additional stations are needed. It would be possible, with such a net-work, to construct upper-air wind charts from which accurate and detailed forecasts could be made. It is to be hoped that Congress will see the importance of providing this additional equipment, for its installation would find a direct and immediate reflection in the increased safety of aviation, and in the increased efficiency of our aerial services.

C. LEROY MEISINGER

WASHINGTON, D. C.

SPECIAL ARTICLES

NOTE ON EINSTEIN'S THEORY OF GRAVITATION AND LIGHT

THIS paper contains a statement of some apparently unnoticed results dealing with light rays and orbits in Einstein's general theory of gravitation. The full proofs will be published in the mathematical journals.

We recall briefly that Einstein, in his general relativity theory, introduces ten potential functions g_{ik} (in contrast with the single function appearing in the Newtonian theory); these are the coefficients in the fundamental quadratic form

$$ds^2 = \Sigma g_{ik} dx_i dx_k,$$

which defines the four-dimensional space-time world $(x_1 x_2 x_3 x_4)$. When there is no actual gravitation the manifold can be written in the euclidean form $dx_1^2 + dx_2^2 + dx_3^2 + dx_4^2$, or $dx^2 + dy^2 + dz^2 - dt^2$ in the usual coordinates. The path of a free particle is then straight, and so is the path of a light pulse.

In the general gravitational case, the ten potentials obey (in space not occupied by matter) a certain set of ten differential equations of the second order $R_{ik} = 0$, where the left-hand members are the components of what is known in the literature as "the contracted Riemann-Christoffel curvature tensor" (Why not call it simply the Einstein tensor?). A free particle then describes a geodesic, or path of minimum length s. Light rays are found by adjoining the condition that ds vanishes. When the quadratic form is put equal to zero, the result will be described as the *light equation.*

I. Our first result is that if an Einstein manifold has straight geodesics it is necessarily euclidean. This means that if, in an unknown field with vanishing Einstein tensor, coordinates can be introduced such that the paths of all particles are expressible by linear equations, then the field is free from gravitation. It is to be noted that curved four-dimensional manifolds with linear geodesics exist: but our result shows that they do not obey Einstein's equations.

II. An analogous result holds for light rays. If in an unknown Einstein field four coordinates can be introduced so that the light equation takes the usual form $dx^2 + dy^2 + dz^2 - dt^2 = 0$, then there is no gravitation (that is, the manifold is euclidean). This requires proof since an arbitrary function may be introduced as factor in the first member without changing the light equation, although this in general changes the field and the geodesics.

III. We pass now to general manifolds where the paths can not be regarded as

straight lines, so that an actual gravitational field exists. We show that the totality of curved paths completely determines the field. Two Einstein fields which are essentially distinct can never have the same paths. In particular, the paths completely determine the behavior of light.

IV. Our final theorem is that the light equation determines uniquely the gravitational field. In particular, the paths of particles can be predicted from the behavior of light in the field.

It follows that the gravitational field produced by the sun can be explored *either* by observations on the orbits of the planets *or* by observations on the deflection of light rays. *It is not necessary to use both sets of observations.* There is, in particular, a connection between the deflection of light (1.7″ at the sun's limb) and the motion of the perihelion of Mercury (43″ per century): either could have been *theoretically* predicted from the other—but in this fairyland who can lay down a boundary between theory and practise? EDWARD KASNER

COLUMBIA UNIVERSITY

THE AMERICAN CHEMICAL SOCIETY.

(*Concluded*)

Some proteins from the Georgia velvet bean, Stizolobium Deeringianum: C. O. JOHNS and H. C. WATERMAN. The Georgia velvet bean contains 23.6 per cent. of protein (N × 6.25). Salt solutions of optimum concentrations (3 per cent.) extract about 15 per cent. of protein. From such solutions 2 globulins, designated the α- and β-globulins, and an albumin may be separated, the 2 former by fractionation with ammonium sulfate and the latter by coagulation from extracts from which the globulins have been precipitated by prolonged dialysis. The proteins are sharply distinguished by their different sulfur- and nitrogen-content, by differences in the percentages of the basic amino-acids as determined by Van Slyke's method, and by the fact that the *β-globulin* does not give the Hopkins reaction for *tryptophane*. The latter observation is of particular interest inasmuch as this amino-acid has been found in all seed globulins heretofore tested. The α-globulin and the albumin from the Georgia velvet bean both contain tryptophane.

The deficiency of cystine in proteins of the genus phaseolus: C. O. JOHNS and A. J. FINKS. Nutrition experiments with the proteins of the navy bean, *Phaseolus vulgaris*, lima bean, *Phaseolus lunatus*, and adsuki bean, *Phaseolus angularis*, show that they are deficient in cystine. This amino-acid must be added before they are adequate for normal growth. The proteins of the navy and lima beans must be cooked as well as supplemented with cystine before they are available. Similar experiments are in progress with the mung bean, *Phaseolus aureus*.

Studies on Neoarsphenamines: P. A. KOBER. It was shown in a previous paper that arsphenamine made by Ehrlich's method contains methylalcohol. It is now shown that neo- and sodium arsphenamines made heretofore contain about 30–40 per cent. impurities, consisting chiefly of methyl alcohol, ethyl alcohol, sulphites and ether. Methods were described for the first time, for making sodium arsphenamine, neo-arsphenamine and a soluble mono-hydrochloride of arsphenamine base, which are chemically pure and whose arsenic and sulfur content is close to that required by the theory. Another method was described for making the dihydrochloride of arsphenamine base.

The colorimetric estimation of tyrosine by the method of Folin and Denis: ROSS AIKEN GORTNER and GEORGE E. HOLM. As the result of a study of the various factors influencing the color intensity of protein hydrolysates to which have been added the phenol reagent of Folin and Denis, according to their directions for the quantitative estimation of tyrosine, we are forced to conclude that: (1) Tyrosine can not be quantitatively estimated in a protein hydrolysate by the use of the phenol reagent because (2) Tryptophane, if present, will also produce intense colors with the reagent, the color produced by one milligram being approximately 85 per cent. of that produced by tyrosine at an equivalent concentration. (3) Indole and indole derivatives, contrary to the statement of Folin and Denis, react strongly with the phenol reagent to produce the blue color. (4) Ferrous iron, and apparently any other easily oxidizable material, also reacts with the reagent. (5) There is considerable evidence that tyrosine and tryptophane are not the only protein constituents which produce blue colors with the phenol reagent. (6) The amount of color which is developed in a solution is not a linear function of the concentration of the reactive material, but the color values fall off

sharply as concentration increases until only an insignificant fraction of the reactive material is indicated by a measurement of the color values of the solutions containing any considerable amount of the reactive substance. (7) Because of the peculiar form of the color curves in relation to concentration, it becomes necessary for one to know the approximate concentration of reactive material in advance of the colorimetric determination so that the colors may be developed and read at such a concentration that the maximum color values will be developed. (8) Because of the fact that solutions of tyrosine and tryptophane do not give the same color values at equivalent concentrations, it is impossible to measure accurately the sum of these amino acids in a mixture which contains no other reactive substances. (9) Protein hydrolysates must not be boneblacked if they are to be used subsequently for a quantitative determination of amino acid content, for the boneblack adsorbs at least tyrosine, tryptophane and tryptophane decomposition products in appreciable amounts. Whether or not other amino acids were adsorbed was not determined. (10) Boneblack contains some easily oxidizable material, probably reduced iron; which dissolves in acid solutions. These acid solutions give the blue color with the phenol reagent.

The humin formed by the acid hydrolysis of proteins. VI. The effect of acid hydrolysis upon tryptophane: GEORGE E. HOLM and ROSS AIKEN GORTNER. Tryptophane was boiled with 20 per cent. hydrochloric acid for various lengths of time up to 144 hours and the solutions studied with respect to deaminization, humin formation and nitrogen distribution. The following conclusions were drawn: (1) Tryptophane is slowly altered and parts of the molecule are broken down by long acid hydrolysis. (2) Tryptophane, in the absence of aldehydes or other reactive compounds, contributes but an insignificant fraction of its nitrogen to the "acid insoluble" humin. A much larger amount of the tryptophane appears in the "soluble humin" after 144 hours' boiling with acid. Since, however, a normal protein hydrolysis rarely requires more than 24 hours' boiling, it appears extremely improbable that the "total" humin of such a hydrolysate is derived from tryptophane without the intervention of some other reactive compound, which we have postulated in our earlier papers to be of the nature of an aldehyde. (3) Tryptophane is relatively easily deaminized by boiling with 20 per cent. hydrochloric acid. probably some of the ammonia of a normal protein hydrolysate is derived from tryptophane instead of being entirely derived from amide groupings. (4) When tryptophane has been boiled with 20 per cent. hydrochloric acid the distribution of the nitrogen is such that errors may be introduced into both the "basic" nitrogen and the "non-basic nitrogen" fraction of a Van Slyke determination.

The alkali reserve in pellagra: M. X. SULLIVAN and R.-E. STANTON. Of fifty-six separate cases tested by alkali reserve by the alveolar air method and by the determination of the carbon dixide bound by the blood plasma, none showed a marked depletion of the alkali reserve, about one third showed a slightly subnormal level, while the greater number of cases were within normal limits. There is little acidosis in pellagra.

The mosaic disease of spinach as characterized by its nitrogen constituents: S. L. JODIDI, S. C. MOULTON, K. S. MARKLEY. Spinach plants, especially their tops, affected with mosaic disease, have a smaller percentage of total, nitrate, acid amide, mono and diamono nitrogen, but a somewhat larger percentage of ammonia than normal plants, nitrous acid being present in diseased plants only. This is due to the fact that denitrification takes place whereby nitrates are reduced to nitrites which reacting on the various nitrogenous compounds present in the spinach bring about elimination of nitrogen in a free state, involving also a loss of nitrogen in the form of ammonia. Very little denitrification, if any, takes place in the roots of diseased spinach. This is evident from the fact that the differences in total, nitrate, amino nitrogen content, etc., of the roots of healthy and diseased plants are usually quite small, running sometimes in opposite direction. Conditions with regard to peptide and protein nitrogen are apparently somewhat more complicated. In the samples examined the proportion of peptide nitrogen is higher in diseased tops than in normal, while the proportion of protein nitrogen is higher in diseased roots than in normal, this being also true of diseased leaves when related to the total nitrogen. This is conceivable since the latter is here *smaller* due to loss through denitrification. In round figures the spinach nitrogen is made up of 55 per cent. protein nitrogen, 4.5 per cent. diamino nitrogen, 5.5 per cent. monoamino nitrogen, and 6 per cent. peptide nitrogen. This means that over 70 per cent. of the nitrogenous compounds occurring in spinach have direct nutritive value.

The effect of conditions on the relation of seed plants to H-ion concentration of nutrient solutions: B. M. DUGGAR. The results of work previously reported indicate that in the preparation of salt (or so-called mineral nutrient) solutions for the solution culture of seed plants under the most favorable conditions, consideration must be given to the hydrogen ion concentration as well as to salt proportions. The hydrogen ion concentrations of carefully prepared and analytically pure monobasic phosphates are for some plants near or above the critical point for growth maintenance. The effects of changes in the environment, especially temperature and humidity affect in no simple manner the response of the plant to changes in P_H. The optimum P_H like the optimum temperature may be represented by a considerable range of values and may be defined closely only in relation to other environmental conditions.

The relation of dextrose to hydrogen ion concentration with B. Coli: WILLIAM H. CHAMBERS. By correlating the property of *B. coli* to produce acid from dextrose with the property of alkali formation in dextrose-free bouillon, it was possible to control the hydrogen ion concentration of a growing culture within a narrow zone by the addition of small amounts of dextrose at frequent intervals. The initial amount of dextrose furnished determined the maximum hydrogen ion concentration attained. Reversion of reaction is demonstrated in bouillon with .3 per cent. or less of dextrose. Growth curves plotted from plate determinations show the inhibitory and lethal effects of alkali and acid.

The determination of small amounts of chlorine in tissues: RICHARD D. BELL and E. A. DOISY. A method, based on that of Neumann, is described for the rapid determination of 3–10 mg. of chlorine in tissues. The tissue is digested with sulfuric acid and persulfate and the gases absorbed in alkali. No cyanide is formed by this digestion process. The sulfur dioxide evolved reduces hypo-chlorite to chloride. The chlorides are precipitated with standard silver nitrate. The mixture is concentrated to a small volume, made up to 25 c.c. and filtered. The filtrate is titrated using the solutions of McLean and Van Slyke. For whole blood and plasma, the results agree with those obtained by Foster's modification of the method of McLean and Van Slyke.

Pectin studies; I. Effect of pectin on the hydrogen ion concentration of acid and of alkaline solutions: H. E. PATTEN and T. O. KELLEMS.

The oxidation of acetoacetic acid by hydrogen peroxide in the presence of glucose: P. A. SCHAFFER.

Influence of fermentation on the starch content of experimental silage: A. W. DOX and LESTER YODER. A study of experimental corn silage at different stages of fermentation which was normal as regards development of aroma and changes in acidity, alcohol and sugar content, leads to the following conclusions: (1) Changes in total acidity, alcohol and sugar are independent of the starch content of the ensiled corn and of the silage produced from it. (2) The first intermediate products resulting from decomposition of starch are not present in demonstrable quantities. (3) The starch content remains constant throughout the fermentation process. (4) The starch granules remain intact, undergoing no physical change that can be detected by microscopic examination.

Water-soluble B vitamines: II. Are the antineuritic and the growth-promoting vitamines the same? A. D. EMMETT and MABEL STOCKHOLM. In previous work in feeding pigeons and young rats the same basal diet as the only source of water-soluble B vitamine, we found that the antineuritic vitamine (pigeons) and the growth-promoting (rats) were not the same. In further studies, carried out on yeast, rats and pigeons, it has been ascertained, by using the Williams quantitative yeast method, that the "vitamine" that stimulates growth in the yeast cell is not antineuritic, as has been claimed, but simply growth-promoting. Further, this "vitamine" apparently has very little if anything to do with the growth of the rat. Therefore, the water-soluble B vitamine appears to be much more complex than many have been led to believe.

CHARLES L. PARSONS,
Secretary

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, NOVEMBER 5, 1920

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

WILLIAM HENRY WELCH[1]

A BIOGRAPHICAL SKETCH

ON this memorable and beautiful occasion I have the cherished honor of having been chosen to perform, as it were, the duties of chronicler, in order that we may all be led to review in our minds the successive steps by which our great leader and master rose to such high distinction and wrought the miracle of giving to medicine a new birth in this country; and in order, also, that our successors, lighting their lamps at the shrine of Pathology and studying the treasures which these precious volumes enclose, may catch a gleam of what manner of man he was who produced them, and by the vigor of his living example and the charm of a rare personality, as well as by the power of his spoken and written word, in the short span of a lifetime raised medicine in the United States from a beneficent art to an expanding science.

William Henry Welch was born in Norfolk, Connecticut, April 8, 1850. He was the son of William and Emeline (Collin) Welch. His father was a practising physician, as were four of his father's brothers. Moreover, a great grandfather and grandfather were also physicians. When about one year of age, William Henry's mother died; thereafter he was

[1] An introduction to the collected papers and addresses of Dr. Welch, compiled in his honor on the occasion of his seventieth birthday, to be published in three volumes by the Johns Hopkins Press under the editorial supervision of a committee consisting of John J. Abel, Lewellys F. Barker, Frank Billings, Walter C. Burket, William T. Councilman, Harvey Cushing, John M. T. Finney, Simon Flexner, William S. Halsted, William H. Howell, John Howland, Henry M. Hurd, Henry Barton Jacobs, William W. Keen, Howard A. Kelly, William G. MacCallum, William J. Mayo, Ralph B. Seem, Winford H. Smith, William S. Thayer, J. Whitridge Williams, Hugh H. Young.

taken care of and brought up by his paternal grandmother, who resided with the father. A contemporary describes the youth as a great favorite in the village, interested in all kinds of sports and athletic exercises. During the Civil War, the youthful William became captain of a company of zouaves, who, dressed in regulation costume and provided with guns, drilled regularly on the village green. When about twelve years old, William was sent to a nearby boarding school at Winchester Centre, conducted by the Reverend Ira W. Pettibone, an uncle by marriage. Here he prepared for Yale College which he entered in 1866, in his sixteenth year, and from which he was graduated in 1870, with the A.B. degree, standing third in his class. During his college period he impressed his teachers and classmates with the possession of the gifts which afterwards distinguished him in so large a measure. After graduation and before entering upon his medical studies, Welch taught school for one year at Norwich, New York.

Thus it was in his twenty-first year that Welch matriculated at the College of Physicians and Surgeons, in New York City. But this first venture into medicine was very brief. An almost prophetic vision into the future gave him pause and led to his return to New Haven for a year of study in chemistry, which field even at that early date he perceived to hold great future possibilities for the study of medicine. This intermediate year was spent jointly at the Sheffield Scientific School and at the Yale Medical School. In the former, Welch came under the influence of Professor Oscar H. Allen who strongly stimulated his interest in science in general and in chemistry in particular. This rather unconventional and solitary personality, who was not only chemist, but geologist, mineralogist and botanist as well, proved to be an inspiring teacher. At the Yale Medical School the professor of chemistry was George Frederic Barker, afterwards professor of physics at the University of Pennsylvania and a member of the National Academy of Sciences, who was deeply interested at the time in organic chemistry and thus turned his pupil's attention to the writings of Kekulé which were just then exerting a dominant influence on chemical thought. Within the year the student was mastering the concepts of Kekulé in the original German. The breadth of interest of the two able teachers under whom Welch had the good fortune to come during this preparatory year, may well have exercised a directive if latent influence on the gifted and impressonable pupil which at a somewhat distant day was to assert itself in the determination to break with the traditional and alluring career of private and consultative practise, and to embark upon the hazardous one of pathology. This decision was not, however, arrived at immediately or even at the outset of his medical work, but came later as part of a widening knowledge and an enlarging experience.

It was fated also that the two men who, each in his own although different way, were to influence the rise of pathology in the United States, should first come together in the chemical laboratory of the Sheffield Scientific School. T. Mitchell Prudden had gone through the school at about the time when William H. Welch passed through the college; but as in that day the two sets of students—academic and scientific—rarely met and never mingled, the two men were not brought into contact. When Welch entered the laboratory, Prudden was already there, filling a kind of voluntary instructorship; and thus the two men whose paths were to cross and recross in the many subsequent years of sympathy, perfect understanding and common endeavor, first discovered in each other, albeit still in embryo as it were, that devotion to science and its ideals which as the years lengthened was to prove secure against the many and insistent allurements and pecuniary rewards of medical practise.

The year of chemical study over, Welch returned definitely to his medical studies. It will aid us a little later in the understanding of the change about to be wrought in the pursuit of pathology—in the making of advances in which the then unsuspecting medical student was to play so large a part—if we pause to sketch in broad outline the kind of educa-

tional discipline offered the medical student at the College of Physicians and Surgeons, a leading institution, in the period embraced by the years 1872 to 1875.

In 1872, when Welch entered, the College of Physicians and Surgeons had been in operation for sixty-five years and led all its competitors in the number of its students and in teaching facilities. The college occupied a building of its own on Twenty-third Street, regarded as commodious, and was a part of Columbia University. The term of instruction had been extended from four to five months, and three instead of two sessions of attendance upon lectures were required for graduation. The precarious supply of material for dissection and for instruction in operative surgery and the method of obtaining it had been superseded and made fairly adequate by legal enactment. The courses in anatomy and to a less degree those in medical chemistry comprised the entire provision for objective or practical teaching, aside from the out-patient clinic at the college and the clinical lectures given at the New York and Bellevue Hospitals and the Almshouse. A voluntary course of lectures on pathological anatomy with demonstration of organs removed at autopsy was offered during the summer session by Francis Delafield.

While the preceptorial system was still in vogue and the medical student was still expected to obtain the main part of his clinical training during the long interval between sessions, in the office and on the rounds of his preceptor, the few outstanding students could hope to enter Bellevue Hospital for an interneship, which might begin even six months before graduation. But the didactic lecture, of which the instruction still chiefly consisted, was expected to fill the mind of the student with the medical lore of the day, while it served also to impress his imagination with the vigorous personality and high authority of the eminent teachers under whom he sat, in a manner now wholly foreign to the spirit of medical teaching.

But to the able, energetic and ambitious student the plan, imperfect as it was as an educational discipline, admitted of a choice of subject and disposition of effort not contemplated in the system. And thus we find Welch in the early period of his medical studies enticed away from the lecture halls into the more alluring atmosphere of the dissecting room and very soon serving as prosector to the professors of anatomy.

With the curriculum as indicated, it is obvious that no opportunity existed to acquire thorough training in any subject, aside possibly from the grosser aspects of human anatomy. The provision for pathology was extremely meager. Although a chair of physiology and pathology, filled by Alonzo Clark, had been created in 1847, in the early seventies of the last century, pathology had not become an independent subject of teaching, but was attached to the chair of medicine, still, as it happened, under Dr. Clark, who had been transferred to the professorship of pathology and clinical medicine.

There is no reason to suppose that Clark treated pathology otherwise than by lectures, with perhaps at most the occasional use of specimens from the deadhouse. On the other hand, Francis Delafield, who had become adjunct professor of pathology and clinical medicine, was already studying assiduously with the microscope the pathological changes in the kidneys in Bright's disease and still other morbid processes, as viewed indeed from the standpoint of the new cellular pathology just struggling into the light. But of opportunity for the student himself to acquire even the rudiments of the technique of the microscopic study of the organs and tissues in health and disease, there was none. It was not, therefore, just at this juncture in Welch's history that his interest in pathology asserted itself.

A compelling circumstance was, however, imminent. Among the prizes offered to students was one provided by Dr. Seguin, then the professor of diseases of the nervous system, for the best report of his clinical and didactic lectures. It consisted of a Varick microscope fitted with superior French triplex lenses. This prize was won by Welch, and it

proved indeed to be the spark which ignited the tinder of his latent interest in pathology and caused it to burst into flame. Fortunately Welch now entered in October, 1874, upon his interneship at Bellevue Hospital, where this strongly aroused impulse was to find an abundant field for expression. He now also came more directly under Delafield's influence, and was thrown with the elder Janeway. Much of his time was spent in the deadhouse performing autopsies, first on his own and then on many other cases; and it is a remarkable tribute to his technical skill and acumen of observation, as well as felicity of description, that Delafield invited him to use his special book for recording the protocols of the postmortem examinations, and that he was made a curator of the Wood Museum attached to the hospital.

Although it was perhaps not clearly perceptible at the time, it now appears that the circumstances surrounding and thus acting upon the sensitive imagination of Welch, the student, were favorable to his development; for notwithstanding the poverty of material resources and of laboratory facilities of the era, he had the good fortune to come under the influence in the medical college of not a few men of remarkable mental vigor and attainments. Besides those already mentioned, there were on the faculty of the college in his day Dalton and Curtis in physiology, St. John and Chandler in chemistry, Edward Curtis in materia medica, Markoe in surgery, Sands and Sabine in anatomy and McLean in obstetrics; weekly clinical lectures were given by Willard Parker and T. Gaillard Thomas, the prestige of whose strong personalities and eminent careers in surgery and in obstetrics and gynecology respectively must have been potent forces. He was thrown as prosector into close association with Sabine and with the demonstrators of anatomy, John Curtis and McBurney. It was especially at the suggestion of Sabine that Welch wrote his graduating thesis upon goiter, which received the first prize, and in the preparation of which he familiarized himself with medical literature and bibliography at the New York Hospital Library. At Bellevue Hospital his contacts with Delafield and with Janeway became numerous and close, the forerunner, as it chanced, of a relationship destined to become even more intimate and significant at a somewhat later period.

Moreover, the era in which the young student found himself was one of fundamental flux of belief brought about by the new cellular pathology and the discoveries of Pasteur just impending. Into this whirlpool of shifting ideas, which were to move in the next succeeding years with ever-increasing speed, Welch with his eager, open and responsive mind was thrown. That his imagination was powerfully stirred by the intellectual ferment of the time may be assumed. One circumstance is, however, quite clear: at this stage pathology as an independent career had not been seriously before his mind, nor was it so to present itself until a whole new set of experiences had been pressed through.

The year and a half's interneship over, Welch is about to take ship for what proved to be for him and us a great adventure. In April, 1876, in company with his friend and fellow townsman, Dr. Frederic S. Dennis, he sailed on the Cunarder *Bothnia* for Liverpool. From Liverpool he went to London, where he spent a few days, crossed the channel from Harwich to Rotterdam and made his way leisurely along the flowering Dutch and Belgian fields as the spring was passing into the mild early summer months, toward Strassburg, the first stopping place on the long but important road which was about to fascinate his view.

Welch's European experience begins with Waldeyer, the director of the Anatomical Institute in Strassburg, with whom he studied normal histology. This subject was of course taken up on account of its fundamental importance as a basis for pathological histology. But it is significant that the interest in chemistry, also as a foundation subject, which carried Welch to New Haven on the very threshold of entrance to his medical studies, had remained alive; hence part of his time

was spent in Hoppe-Seyler's laboratory, under the master himself and his assistant Baumann, in working through the former's well-known text-book in physiological chemistry. In addition, time was found to attend von Recklinghausen's autopsies and demonstration course, although at this period no further courses were taken with this master of pathology and for the reason that Welch concluded that until a grounding in normal histology was secured, it would not be profitable to pursue pathological histology.

The summer semester at an end, Welch left Strassburg for Leipzig, the summer vacation being spent with a friend in a pedestrian tour in Switzerland and northern Italy. It is of interest to inquire just what was the lure of Leipzig. Obviously Waldeyer was the attraction in Strassburg; now it was Heubner and Wagner who drew the student to Leipzig. At that time Heubner had not entered the field of pediatrics in which he afterwards became celebrated, but he was working rather in the field of neurology; and, indeed, it was his important book on the diseases of the blood vessels of the brain,[2] which Welch had read, that determined the choice. If we undertake to penetrate further into the source of Heubner's attraction for Welch, we are led back to the days at the College of Physicians and Surgeons in New York and the lectures of Seguin which had exerted a strong influence on Welch, so that if we had then inquired whither he was tending in medical specialization we should have discovered that he was looking to diseases of the nervous system as the field for practise, while pathology remained his main interest and subject of training in Germany, although he could not then anticipate its pursuit as a means of livelihood on his return to America.

Circumstances were, however, to defeat this consciously worked out program. In due course Welch subscribed for Heubner's course, only to find very quickly that the latter was not then interested in teaching; soon the course began to languish and the students to absent themselves, and it was not long until Welch was looking elsewhere to fill his time. Wagner, who later succeeded Wunderlich in the chair of internal medicine, was at the time professor of pathological anatomy. Welch found Wagner's courses and the opportunities afforded for independent work by his institute admirably adapted for his own purpose. Here he attended autopsies and obtained specimens of tissue for microscopic examination. At first the blocks were given as a favor; but later, Wagner's interest having become aroused, he would personally select the specimens for examination and for report. In this manner Welch occupied his mornings; the afternoons were, however, still free. He attended Wagner's polyclinc, which kept him in touch with practical medicine.

[2] Heubner, "Die luetische Erkrankungen der Hirnarterien," Leipzig, 1874.

At this period Ludwig's laboratory was the center of attraction for the talented men in Germany and also for many foreigners especially interested in physiology. Welch decided to offer himself and was accepted by Ludwig. That the choice was a propitious one is shown by the group of men at that time working with Ludwig and with whom Welch was now associated. The first assistant was the gifted and inspiring Kronecker with whom Welch formed an enduring friendship. Among foreign students was Pawlow, and Drechsel and Flechsig were in charge of the chemical and the histological divisions of Ludwig's laboratory. Welch was set by Ludwig to study the ganglia and nerves of the auricular septum of the frog's heart with the gold chloride impregnation method, in the course of which he actually brought into view the ganglionic cells with T-shaped fibers which Ranvier described in detail somewhat later. The semester closed and the usual *Abschied* supper was given by Kronecker. Of course Welch was invited and there was characteristically exhibited a model of the ganglion cells with fibers both entering and leaving it—a novel and as we now know a histologically highly important event.

The first year of Welch's European study was now over. It had been spent in preparing himself in normal histology, physio-

logical chemistry, pathological anatomy and physiology; and it may be asked to what purpose and for what ultimate end? The answer is, in order to be ready to study with Virchow, whose institute he had visited during a short stay in Berlin. This expectation was indeed the force back of the concentration on normal histology, the reason for embracing eagerly a histological problem from Ludwig, the motive in following Wagner's autopsy and microscopic courses; and, after all, the wish was to be frustrated and Welch's activities were to be directed along a wholly new direction and into fresh channels.

The new impulse came from Ludwig who did not share the enthusiasm, at least in the overwhelming degree then current, for the cellular pathology of the period. Perhaps this response was the less hearty because he did not have the strong sense, as so many seemed to have, of a great innovation, but rather viewed Virchow's doctrines as the extension, perhaps even the consummation, of the earlier conceptions and discoveries of Schwann, Schleiden, Remak and Reichert; or possibly it was his physiological bias or even a subtler appreciation of the impending influence of the study of function on the growth of pathology, which led him to induce Welch to alter his plans and to offer himself to the brilliant young pathologist Cohnheim to whom he undertook to write urging him to receive Welch and to furnish him with a rewarding (*lohnendes*) theme.

This choice proved highly fortunate. As one review's Welch's own published work, his immediate influence on his students, or the more general effect which his career has had on medical education, it is now quite obvious that his intellectual temper was of the order called dynamic, and his vigorous responses were to concepts built on facts of function far more than of form and structure. The summer semester of 1877 with Cohnheim in Breslau was perhaps the most delightful and satisfying of all the time Welch spent abroad; and fortunately we possess a pen picture of him at that particular time, drawn in clear and sympathetic lines.

Salomonsen, afterwards professor of pathology at Copenhagen and the present Nestor of medicine in Denmark, had also come to Breslau for the summer semester. The two foreign students, the first foreigners who studied with Cohnheim, were at once thrown together; there existed, indeed, that subtle quality in the temperaments of the two men that quickly made for close association and then intimate friendship—a rare relation which neither distance nor fleeting years have severed. Salomonsen states that the two men who most influenced his own life were Carl Weigert and William H. Welch. He goes on to enlarge and say that he and Welch had many points of contact: both were sons of physicians, both on return to their own countries hoped to become pathologists to municipal hospitals, and both regarded it as a matter of course that any one wishing to enter on the career of pathologist should aspire to work under Cohnheim.

The two foreigners were proud of the distinction—what two eager young men would not be?—of being the only foreigners in the laboratory among such present or prospective stars as Weigert, Ehrlich, Lassar, Lichtheim, Albert Neisser, Senftleben and O. Rosenbach. They were always together—from early morning to late afternoon—and they were taken up cordially by their German colleagues of whose intimate circle they made a part. I venture to quote a particularly appropriate paragraph from Salomonsen:

> That by accident I should have found so gifted a man and investigator as Welch in Breslau, I at that time, as well as later, regarded as the greatest good luck. Cohnheim knew well how to appreciate Welch, and he recommended him for the professorship of pathology at the Johns Hopkins University where Welch exerted a profound influence on the development of medical education in the United States, and where the present generation of American pathologists call him master.

It was in this remarkable atmosphere that Welch spent a precious semester. The work of the laboratory was pretty sharply divided between the autopsies conducted mostly by Weigert, and the experimental investigations

in which Cohnheim shone ever brighter and brighter. The particular problem which Cohnheim assigned to Welch was the ascertaining of the origin of acute general edema of the lungs. This is perhaps not the place to go into minutiæ of that splendidly conceived and executed piece of experimental work. It was in many ways fortunate that Cohnheim was too preoccupied at the time reflecting on his theory of tumors and in the preparation of his text-book on general pathology to do more than propose the problem which Welch developed largely according to his own notions of logical sequence. Cohnheim, indeed, was greatly surprised when, contrary to his preconception of the process, Welch found the factors involved in it to be mechanical. The masterly paper describing this piece of work as it appears in *Virchows Archiv* was written out by Welch in German and printed quite as he prepared it. Cohnheim seems not to have altered essentially the composition, the mode of presentation or the conclusions arrived at. Unfortunately for future controversy Cohnheim misconstrued the implications of Welch's experiments and in his epochal Lectures on General Pathology he substituted for the term disproportion (*Missverhältniss*) employed by Welch to express the disharmony (often caused by spasm) in action of the two cardiac ventricles, the term paralysis (*Lähmung*), which implies only one form of disharmony.

The by-products of this semester on Welch's development were as important as the direct influences. Salomonsen's studies on tuberculosis of the eye initiated him into the experimental side of the tuberculosis problem. Salomonsen relates an incident showing the great impression made upon the two foreign students by the first example of generalized tuberculosis in the guinea pig which they observed. Their enthusiasm evoked hearty laughter from Cohnheim. It was, moreover, the period of Heidenhain's early brilliant work, of the rich harvest of Cohn, the botanist; and to cap the climax, the occasion of Koch's visit to Breslau to lay before Cohnheim and Cohn the facts of his studies on anthrax in the demonstration of which all the workers in Cohnheim's laboratory were permitted to share. Finally, Weigert with Ehrlich was just applying the aniline dyes to the staining of tissue elements and bacteria and had recently completed his study of smallpox, in the course of which he demonstrated by staining methods the masses of micrococci within the pustules. Ehrlich also, although not yet graduated, was literally dabbling in the aniline stains and it was a common event to see him with hands covered up to the wrists with dyes of many colors. The close friendship of Welch with Weigert and Ehrlich dates from this period.

It is significant that the spirit of the Institute was favorable to the new bacteriology and that Cohnheim and his associates were all looking to the new science to unlock doors still concealing the origin of the diseases called infectious—an attitude striking in its difference from the skeptical and rather disdainful one of the Virchow school of pathology. Thus on leaving Breslau, Cohnheim sent Welch to Vienna by way of Prague, in order that he might visit Klebs, who was engaged in the study of acute endocarditis from the microbiological side. There he spent several stimulating days, during which Klebs showed him through his excellent museum and demonstrated his preparations showing microorganisms (micrococci) in the ulcerative lesions of acute endocarditis. The impression which Klebs made upon Welch was very strong; and in the light of present knowledge, the accuracy and prescience of Klebs' work, well in advance of his period, not only on endocarditis but on diphtheria and experimental syphilis as well, have become clearly apparent.

The next stop in the educational journey was made at Vienna which was still a kind of Mecca for foreign medical students of all nationalities. The immediate objective was a place in Stricker's laboratory, in order to continue his studies in experimental pathology. As an index of the high feelings prevailing at the time it may be mentioned that once Stricker learned that Welch had been with

the heterodox Cohnheim who taught that the pus cell was merely an emigrated leukocyte, he was not inclined to receive him as a worker in his laboratory. One purpose of the visit to Vienna was to study embryology under Schenck, but the choice was not fortunate and Schenck was soon forsaken. It is interesting to note that Welch and Prudden found themselves together in Vienna in their search for an opportunity to study embryology.

On the whole, the chief lure of Vienna for the pathologist was its almost inexhaustible store of pathological anatomical material. The reign of Rokitansky was over, and his successor was Heschl, the discoverer of the methyl-violet reaction for amyloid, but a far less significant personality. The greater attraction was the young Chiari, who was teaching and working with the vigor which afterwards became so notable and carried him by way of Prague to Strassburg to succeed the eminent von Recklinghausen. To him Welch went, but not to spend his entire time. There survived in his mind, it appears, a residue of distrust that pathology would after all afford him a career in America, or was it the love still for the more immediately practical aspects of medicine which led him to enter upon courses on the skin under Hebra, on neurology and psychiatry under Meynert, on the eye and other special subjects? But Vienna meant for Welch much more than gross pathology and the medical specialties. The great city with its splendid museums of art, its grand opera, and its vivid life introduced features of another order into his experience, feeding that general culture in literature, history, and the fine arts which came to distinguish him quite as much as his many-sided medical attainments. Welch remained in Vienna until the Christmas holidays, when he turned his steps for a second time toward Strassburg, spending a few days *en route* in Würzburg with Rindfleisch and his assistant Ziegler.

The second pilgrimage to Strassburg was the carrying out of a plan formed by Welch at the outset of his European study. He recognized in von Recklinghausen the outstanding representative of the Virchow school of pathologists, and his attendance upon the autopsies at the Pathological Institute, while he was a pupil of Waldeyer, had stimulated his zeal to work directly under the master. This desire could not be at once appeased, for as we have seen, Welch lacked the preparation in normal histology which he regarded as essential. But now that this requisite was supplied and the work with Ludwig and with Cohnheim had provided a fair foundation for further building, Welch offered himself to von Recklinghausen and was accepted.

As another indication of the commotion which Cohnheim's investigations were making in the placid waters of Virchowian pathology, it may be cited that once von Recklinghausen learned Welch was fresh from the laboratory of that heretical pathologist, he chose as a theme for his special study the inflammation of the cornea of the frog induced by various caustic chemicals. The essential point of difference involved in the contentions of the Virchow and the Cohnheim schools related to the origin of the pus cell. Was it derived by multiplication from the fixed tissue cells, or was it a leukocyte emigrated from the blood? The controversy has long been setled in favor of the latter, or Cohnheim view; but in January, 1878, and for many years thereafter it raged with vigor and even bitterness. The cornea was selected because of its condition of non-vascularity. The novel experimental procedure employed at von Recklinghausen's suggestion by Welch was the excision of the cornea after the injury and immersion in the aqueous humor of the frog or bullock, and observation continued over long hours under the microscope. That cells moved toward the injured spot in the non-vascular specimen was shown beyond peradventure and even that they divided; what was simpler, therefore, than to conclude that migration is not dependent on the presence of the blood, and hence pus cells are not translated leukocytes? This inference, however, was not drawn by Welch, who recognized that the reasoning is fallacious. The full explanation of the observed phenomena waited on later studies and even on recent

discoveries. We now know that connective tissue cells, among which the corneal corpuscles and the cells of Descemet's membrane are classed, are motile; and as cells endowed with movement they are attracted by certain stimuli called "chemical," such for example as arise in tissue constituents acted on by chemicals and in other ways. Moreover, as we now know, these fixed tissue cells readily multiply *in vitro,* and thus we arrive at the conclusion that the chemically altered spot in the cornea attracts toward itself neighboring uninjured, motile corneal and other cells, that these cells aggregate about the site of the injury and even multiply there, and thus give what may be called a spurious appearance of a collection of pus cells. For it should be remembered that we are dealing with a period in which tissues were not yet being stained with certain nuclear and other dyes that bring into view brilliant and subtle distinctions of cellular structure; but that the "inflamed" cornea was merely silvered in order that the cell outlines might become perceptible, and, if desired, was subsequently stained with hematoxylin to show the nuclei.

This practise of putting to the test new discoveries and contentions even under somewhat hostile circumstances was not a poor discipline for the future teacher of pathology in the United States. The experience may indeed be regarded as having brought into play under favoring circumstances a critical faculty inclined perhaps to leniency, while it held up as it were to the mirror of his perceptions in a somewhat summary fashion the facts of the ultimate and ineradicable residue of personal bias in all men, no matter how great. In the long future years during which Welch dispensed knowledge and, what is rarer, wisdom at the Johns Hopkins University and elsewhere, he came as near as it is perhaps possible for a mere mortal to come, in escaping the blemish of preconception and prejudice and in preserving and presenting the ideal of the open though balanced mind.

But it would be wrong to infer that there was not also a constructive side to this period with von Recklinghausen. The pathologist was great in attainments, and stimulating as a teacher. He engaged Welch in discussion of many topics in pathology which were current at the time. One of these related to the origin of tumors, regarding which von Recklinghausen was endeavoring to formulate his views along lines which have since become more familiar. He inclined to the conception that a kind of fertilization, whether by conjugation or otherwise, took place among the cells, leading to the unconstrained multiplication characteristic of cancer and other tumors, in consequence of which irregularities of division arose that were the striking obvious signs of the cellular abnormality. Welch always retained an admiration for von Recklinghausen as a great pathological anatomist.

The first European adventure was now approaching its conclusion and was to receive a suitable ending by a first visit to Paris and a second to London. It is far simpler and more satisfying perhaps to leave to the imagination the picture of Welch in the great and beautiful French city with its wealth of present interests and of historic backgrounds everywhere insistent. The fact may, however, be mentioned that time was found during the two or three weeks of his stay to hear Ranvier, whom he admired greatly and whose book on histology had been his guide, and to visit the main hospitals. In London he heard Lister lecture at King's College Hospital, and shared in the prevailing excitement which arose from Lister's daring surgical exploit of opening the knee joint. The next was the final act, namely, taking ship at Liverpool for the United States.

The arrival in New York in the spring of 1878 brought forward a question which could be permitted to remain in the background in Europe, but now must be answered. Undoubtedly Welch possessed wares garnered at home and abroad—but to what market were they to be taken? That the practise of medicine would be a necessary corollary to any other ambition he might indulge, seemed never to have been doubted by him. Where else were the necessary pecuniary rewards to come from? There seemed no alternative but to decide im-

mediately whether he should choose New York or Norfolk as a field of operations. In Norfolk his father was still busily, if not very remuneratively, engaged in country practise, in the course of which he dispensed much kindness and, according to tradition, worldly wisdom with his medicines. It strikes one now as very odd that Welch should have hesitated at this juncture in his choice of New York or of Norfolk. The anomaly can best perhaps be explained by taking into account his remarkable modesty. It seems almost impossible of belief that one so gifted and innately so forceful should not be aware in some degree of the part which nature had cast for him. But whatever pangs of indecision he may have suffered were about to be allayed by destiny in the form of Dr. Goldthwaite.

Success in attaining interneships in hospitals or appointments to the medical services of the Army and Navy was still determined by the results of competitive examination. To meet this situation the private "quiz" had arisen and operated about the medical schools and upon the aspiring medical students. The practise has now been generally discredited and discontinued; but in 1878 and for many years afterwards the "quiz" if successful was a reputable and a relatively highly remunerative affair. The "quiz" masters adapted the cramming process to the peculiarities and foibles of the individual examiners, which they sedulously set themselves to learn. It is now obvious that on joining Goldthwaite's "quiz" Welch never regarded the undertaking as more than a stop-gap. It should not now surprise us to learn that the combination of Goldthwaite and Welch proved irresistible and soon outdistanced all competitors; it could choose the most promising students and its product gained the prize interneships. Welch endured the "quiz" three years, after which and while it was at the height of its popularity he withdrew. The reason is sufficiently apparent now, but then with the system intrenched as it were, it required insight and force to convict it of its salient defect, namely, that of being a bad method, viewed from the standpoint of educational discipline.

The "quiz" was, after all, merely an incident, the main import of which was that it ensured the necessary income, while leaving much of Welch's time for more engrossing pursuits. As a matter of fact, Welch had offered himself for practise and occupied at this period rooms with his friend Dennis at 21 East Twenty-first Street, adjacent to the office of his old teacher, Alonzo Clark, who would refer occasional patients to the young men. The volume of Welch's practise never became embarrassing, so that he was still free to follow his major bent, which was to teach pathology.

The outlook for pathology in New York in 1878 was not bright. The extent and the nature of the teaching had not changed materially since Welch was a student in the medical college. New York was as much cut off from the strong currents moving in Germany and France along the three main lines of pathology—pathological anatomy, experimental pathology and bacteriology—as if Europe and America were not connected by a common intellectual bond. Welch was, indeed, destined to play the principal part in breaking the barrier of American isolation, but at this time when he was offered by Dr. Francis Delafield the lectures on pathology during the summer semester at the College of Physicians and Surgeons, he declined the opportunity, because it carried with it no chance to set up a laboratory, which was the one essential of Welch's aspiration. But what was denied him at the College of Physicians and Surgeons was about to be put before him at Bellevue Hospital Medical College. This rival institution proposed to build two small rooms over a hallway, which, added to another room, Welch could turn into a laboratory.

The invitation was accepted at once, and Welch made his first break with the established traditions in New York. For this was the heyday of schism in medical schools and feelings ran high among the several faculties, and the position of his alma mater, the "P. and S.," in the medical hierarchy of the time was regarded as supreme. Certain of Welch's friends were not happy over his choice and even considered that he had made "the mis-

take of his life." Perhaps there were disadvantages of a kind in a Bellevue connection as contrasted with the far greater prominence of the "P. and S." establishment, but whatever they may have been in general, they were more than compensated for by the laboratory and its proximity to the deadhouse at Bellevue. The new pathological laboratory became at once an influential factor in the medical educational system of New York, and students came there to Welch from all three medical schools.

The leaven worked rapidly; for very soon the College of Physicians and Surgeons awoke to the growing demands of pathology. A part of the faculty had not ceased to view Welch's defection regretfully, and now that the Alumni Association proposed to set up, under Delafield's general direction, a pathological laboratory, its direct conduct was offered at Welch. The invitation was not accepted, but in declining it Welch characteristically, as we should now say, put in another strong stroke for pathology, as the following letter, which also explains his sense of obligation to the Bellevue College, illustrates:

NEW YORK, October 9, 1878.

My dear Dr. Prudden: A few days ago Professor Delafield told me of the following scheme which the Twenty-third Street Medical College has on foot. A laboratory for histology and pathology is to be established in connection with the college, by means of a fund given for the purpose by the alumni. It is to be taken hold of in an earnest way, for the laboratory is to hold the same relation to the college as the dissecting room does; that is, each student will be obliged during some part of his course to work there before he can take his degree. Dr. Delafield proposed that I should go in as his first assistant and have charge of the histological department, and assist him as much as necessary in the pathological part. The salary was to be five hundred dollars for the first year, and I believe more subsequently. I was naturally delighted with the offer and thought it to be just what I wanted, an opportunity to work in the direction where I had studied most. Upon speaking of the matter, before coming to a decision, with some of the professors at Bellevue, I find that they are reluctant to have me leave there, and even represent it as not the square thing for me to go at present. The latter motive especially has influenced me to stay, as I do not believe it pays to do anything unfair. I feel as if I were relinquishing a great opportunity and do not see any equivalent for it at present at Bellevue, but as there is a feeling there that it would not be right for me to leave, I am going to stay and have so told Dr. Delafield. He asked me if I knew any one who would be competent for the position, saying there are a great many in New York who think they are, but few who really are.

I immediately suggested your name and he at once seemed pleased, and deputed me to hunt you up by a letter and communicate the proposal to you. I really think the offer an advantageous one, in fact presenting an opportunity better than any other I know for one with the tastes and resolution which you have formed. I do not know any one who could do greater justice to the work there than yourself, and it seems to me to present great possibilities for the future. Personally I should like to have you here in New York, for I fear I am going to rust out unless I have some one to talk with and help me on concerning the subject in which we are both interested.

I do not know whether this letter will even reach you. Will you at least drop me a postal card when you receive it, for if I do not hear from you in a day or two, I am going to resort to further means of hunting you up. I should also like to know how you decide.

With Prudden's installation at the College of Physicians and Surgeons, pathology had come to be recognized as a subject of independent merit and proportions, to be taught practically, by two of the leading medical schools of the country. Prudden was a pupil of Arnold of Heidelberg, under whom he had mastered a precise and delicate pathological histological technique; and later at Vienna, in part alongside Welch, he had imbibed the essence of the teaching of morbid anatomy. Thus and at last in the persons of Welch and Prudden, American pathology had come to be united with the best sources of its inspiration abroad; and from now on the main task was to widen and diversify this stream in the accomplishment of which purpose Welch's career stands forth preeminent.

Welch was now fairly launched on a career

in pathology, but his struggles were not all over. The serious question all along was the economic one. Pathology was not a remunerative profession at the time. The fees from students taking the course were small, the occasional windfall from a private autopsy was precarious. There were, of course, the fees for the examination of specimens for physicians and surgeons and the possibility existed then as now of turning this practise into considerable income. But Welch shrank from an enterprise which would consume his time and yield no corresponding scientific return. After the abandonment of the "quiz" a way out was found in that he became, first, assistant demonstrator and later demonstrator of anatomy at Bellevue, both paid positions; and then he offered himself for practise. That his neighbor and teacher, Alonzo Clark, sent him patients, we have seen; it remains, however, to add that the now elderly gentleman formed the habit of referring his surgical cases to Welch.

This was also the period of Welch's association with the elder Flint, then at the zenith of his prominent career as teacher and consultant. He was professor of medicine and the leading spirit at the Bellevue College, and a great social and professional figure in New York. Flint was engaged at the time in bringing out a new edition of his Practise of Medicine and asked Welch to revise the sections on pathology. Welch "jumped at the chance" and was given a free hand, except for two or three topics which were reserved for his son, Austin Flint, Jr. Any one to-day reading Flint's Practise of Medicine will recognize the superior merit of the introductory chapters on general pathology and the sections on the pathology of the special diseases there given, the whole amounting to a text-book on pathology.

It was Flint's habit to precede his lectures on "practise" with a sketch of the pathology of the subject to be presented. Pretty soon these preliminary lectures were turned over to Welch, who lost apparently no opportunity to increase the prestige of pathology in the curriculum. Thus he introduced the class autopsy, which he held once a week in a room filled with students. Notwithstanding these clear indications of Welch's unmistakable bent and trend, Flint assumed all along that Welch would become a consultant and succeed him in the professorship of medicine. Indeed, he took steps by having the faculty elect Welch to the clinical professorship of medicine to make his succession certain. Welch on learning of this action brought about its revocation, first, because of the injustice which he considered done to the then incumbent of the clinical professorship, and next because of his great interest in pathology.

Looking backward it can be perceived that these many shifts and activities were incidental to the laboratory of pathology. First, the "quiz"; second, the demonstratorship in anatomy; third, practise—each in turn supplied the necessary income in money to cover living expenses. Each in turn was followed with energy and success, and abandoned as soon as the needed income was available from a source less exacting of the precious time to devote to autopsies and laboratory, or freer from considerations violating fundamental beliefs in sound educational method. Pretty soon his skill in performing autopsies and his eagerness for pathological material brought to Welch privileges from the Babies' Hospital and also from the coroner, with whom Welch stipulated that he was not to testify in court. It is of passing interest to note that none of these were paid positions, but that at this time a small stipend came to Welch from the registrarship of the Woman's Hospital, which position he then held, and where he made the autopsies and studied the specimens, mainly ovarian tumors, removed at operations.

Half a dozen years had passed since his return from the European studies, and Welch had intrenched himself deeply in the medical life of New York. He was the outstanding pathologist and representative of the new pathology, and there came to him to study or to work, the alert and ambitious among the medical students and young practitioners of the day. These years had contained not a little that was pleasant, but much also that was discouraging to one who possessed a deeper feel-

ing for and a wider outlook on medical education. It is true that improvements were creeping into the medical curriculum; the annual sessions at this time were indeed extended from five to seven months and more emphasis was being placed on the laboratory and less on the purely didactic form of instruction; but progress was painfully slow and medical teaching lagged sadly behind that of continental schools. However, a turn in medical affairs was impending which was to transform within a few years the entire educational structure.

The Johns Hopkins Hospital was approaching completion and the thoughts of President Gilman and the boards of trustees of the Johns Hopkins University and Hospital were turning toward the establishment of the medical school provided for in the splendid gift of Johns Hopkins. A leader to guide the new enterprise was sought, and it is quite clear from Salomonsen's statement that President Gilman asked Cohnheim's advice, and doubtless the advice of others at home and abroad. Welch seems to have been the unanimous first choice. Dr. John S. Billings, so intimately associated with the planning of the hospital, visited Welch at Bellevue, doubtless in this connection, and Welch was invited to become professor of pathology in the university and pathologist to the hospital. The great opportunity for which he had waited and labored and toward which his dearest aspirations turned had now come to Welch.

There was no doubt in Welch's mind that the Baltimore venture was full of promise and should be embraced. In the meantime, however, his position in New York had become so important, it is not surprising that a strong effort should be made to retain him. At first Welch's friends failed to see how any one could exchange the professional opportunities of New York for those of provincial Baltimore. The incidents of the transition from the "P. and S." to Bellevue College were recalled in this almost grotesque adventure. But there was no doubting Welch's seriousness, and hence steps were taken at once to thwart his plans. The fear of losing Welch was the immediate incentive which brought the Carnegie Laboratory into being. Dr. Dennis, an intimate friend and admirer of Welch, obtained a sum of $50,000 from Mr. Carnegie for the erection of the laboratory. But there is reason to believe that Dr. Dennis had in mind, besides the purpose of anchoring Welch to New York, the setting up of the laboratory as an integral part of the medical educational system of the United States.

But the Carnegie Laboratory was, after all, a building only, with such simple and necessary equipment as was demanded by the work of the period in pathological anatomy and in bacteriology, just at its beginnings in the United States. There was no provision made for a paid staff, and there were no funds for daily running expenses. Just what might have happened had these essentials been provided, it is impossible to say, for undoubtedly with the erection of the Carnegie Laboratory the outlook for pathology in New York had suddenly brightened. But the vista opened before Welch's eyes at Baltimore was extremely fascinating, and strong as now may have been the motive to remain in New York, the unprecedented position which the Johns Hopkins University, at the zenith of its great reputation, had attained in fostering science, was a lure not to be resisted. Everything about the opportunity at Baltimore attracted Welch, who wished above all to be free to develop pathology in a manner approaching that which he had come to know in Germany; and fortunately for the history of medical progress in the United States, he yielded to manifest destiny, although in doing so he was breaking with old and devoted friendships and turning his back on a position in New York never yet attained by a devotee of a laboratory branch of medical science.

In the six years which had elapsed since Welch had returned from his first period of foreign study, the center of interest had begun to shift from the purely cellular pathology of Virchow to that of the microbiology of Pasteur and Koch, in which the bacteria appear as the direct incitants of disease. Here at last, it seemed, were to be discovered the

agencies whose actions are the immediate excitants of those organic and cellular changes or lesions constituting the visible reactions of the tissues to the injurious influences taking place in the course of the phenomenal process designated disease. This new direction of development was highly sympathetic to Welch who had been a spectator at Breslau, at the prologue to this swiftly moving drama, when Koch visited Cohn and Cohnheim in order to exhibit his anthrax cultures. Welch desired first-hand knowledge of and experience in the new field, and as the Johns Hopkins Hospital was still in process of construction, we find him setting out again, in the summer of 1884, for Germany.

The new goal was Koch in Berlin. But an interview with him at the *Reichsgesundheitsamt* led Welch on Koch's advice to go to Munich for the autumn to study under Frobenius in Bollinger's laboratory, preparatory to work under the master at a later date. It appears that Koch was soon to leave the *Gesundheitsamt* to be established in the Hygienic Institute under university auspices, near the Alexanderplatz. Frobenius proved a slavish teacher of Koch's technique, which he communicated to his pupils along with such comments as he had gleaned from conversations with Koch. Still, it was a beginning in the new field and the relatively unfavorable conditions led again, as once before at Leipzig, to connections of great future importance. Here Welch made the acquaintance of Hans Buchner and also of Escherich, Lehmann, Neumann, Celli and others who had come to follow the first course in bacteriology given in a university. Especially with Celli, who had already begun his studies of the malarial parasite, he formed an intimate and enduring friendship. Welch followed at this time Kitt's demonstrations in animal pathology in the veterinary school and worked in von Pettenkofer's institute of hygiene with the master himself and his assistant, Renk. All was grist that came to Welch's mill for in after years the former experience was to bear fruit in his important studies on the swine diseases and the close interest in Theobald Smith's work, and the latter to contribute to that comprehensive grasp of the subject of hygiene now being embodied in the new school of public health at Baltimore, his latest and highly remarkable creation.

Welch did not go at once from Munich to Berlin but acting still under Koch's direction went in January to Göttingen to work under Flügge, who was professor of hygiene and much closer to Koch and being advised by him. This period was in every way advantageous, as Flügge was a far more inspiring and systematic teacher than Frobenius, and his influence proved lasting and valuable. Here again he became acquainted with fellow students gathered in Göttingen for the same purpose, who afterwards became distinguished bacteriologists, such as MacFadyen, Nicolaier and Wyssokowitch.

The final touch in Welch's preparation in the new bacteriology was administered by Koch—a vivid teacher—who himself conducted the courses, which he had previously organized for military doctors which had such far-reaching consequences. Fortune again threw Welch and Prudden together, for the latter who had taken over the laboratory at the College of Physicians and Surgeons established by the Alumni Association, was now in Berlin also seeking training in the new science of bacteriology. The course, which was of a few weeks' duration, consisted essentially in the practise of isolating bacterial species by means of Koch's solid culture technique or by passage of them through the animal body, in order to effect separation of virulent from other varieties, and in the consideration of form, staining reactions and physiological and pathogenic propensities. The climax of the course was the study of the bacillus inducing Asiatic cholera. At this period not a little apprehension existed that Europe might again be visited by that scourge. The disease had raged in India and Egypt and the year before had gained a foothold in Europe in certain Mediterranean ports—hence the desirability of mobilizing a small army of trained bacteriologists to combat that plague should it threaten in earnest. Koch himself was deeply im-

pressed with the danger; indeed so appalling did he consider the calamity of an epidemic outbreak of cholera in Europe that he did not trust himself to bring with him to Berlin cultures of the bacillus isolated in India or Egypt, but preferred to destroy them lest by inadvertence they should gain access to food or water. Now, however, that cholera actually existed on European soil and danger of its spread was imminent, the circumstances not only justified but compelled instruction in its bacteriological detection, and for this purpose he went to Toulon to secure anew fresh cultures.

But Koch admonished his pupils not to carry away from the laboratory living cultures of cholera bacillus. This piece of sound advice, following the end of the course at a *Kneipe* held in honor of the *Geheimrath* led to an amusing incident. The next morning Welch and Prudden met accidentally at an early hour on one of the bridges spanning the Spree, each, as it seems, seeking secrecy. It developed that each had gone to an apothecary's shop and purchased concentrated sulphuric acid (or was it a saturated solution of corrosive sublimate?), which they had poured over the surface of tube cultures of the cholera bacillus originally intended to take with them to America and that they now proceeded to drop into the Spree. They expected, of course, to see the tubes sink immediately out of sight, instead of which they had the momentary disquieting experience of observing them bobbing up and down as they slowly floated down stream. The guilty pair hurried away, just, it is said, as a large *Schutzmann* appeared on the scene.

An impression of Koch and the influence of his instruction at the time is given by Prudden:

> Thus the course in the study of bacteria, of one month's duration, in Koch's laboratory was brought to an end, and the writer can not refrain from remarking that the calm, judicial mind of Dr. Koch—the master worker in his field—his marvelous skill and patience as an experimenter, his wide range of knowledge and his modest, unassuming presentation of his views are all calculated to inspire confidence in the results of his own work, to stimulate his students to personal exertion in this field, and to lend certainty to the already widespread hope that ere long through the resources of science we shall be able to cope successfully with those most terrible and fatal enemies of the human race—the acute infectious diseases.[3]

Welch arrived in Baltimore in September, 1885, and there found Councilman at work in pathology. He immediately joined Welch and together they set up a laboratory in a couple of rooms on the top floor of the biological laboratory, offered them by Newell Martin. The two-storied building at the hospital, designed as a deadhouse, was hurriedly completed and converted into a pathological laboratory. This arrangement was intended merely as a stop-gap in the emergency and until the buildings for the medical school, then expected soon to be organized and constructed, could be provided. As it happened, the consummation of the medical school project was long delayed and the small quarters intended merely for a deadhouse and its essential adjuncts, became the permanent home of the pathological department, as well as indeed the actual physical foundation on which were later erected two additional stories to house temporarily the departments of anatomy and pharmacology of the medical school. When in a few years those two departments secured elsewhere other and more adequate quarters, the pathological department spread through all the vacated space, which, in view of its expanding activities, was sorely needed.

The history of the pathological department of the Johns Hopkins University and Hospital, that was to play so profound a part in the educational progress of the United States, dates from 1886, at which time Welch began to exert the influence which peculiarly distinguishes his career from that of his predecessors in this country and elsewhere. Hitherto there had been abroad departments or institutes of pathology by which was usually meant pathological anatomy and his-

[3] Prudden, T. M., on Koch's method of studying bacteria. Report to the Connecticut State Board of Health for 1885, pages 225–226.

tology, and sometimes experimental pathology or bacteriology. Welch's receptive and constructive mind responded powerfully to the training he received in these several branches of science, so that he became master not of one branch only, but of all. Thus it came about that in setting up the pathological department in Baltimore he inevitably, and doubtless unconsciously, employed all these resources of knowledge and progress, and in so doing inaugurated a new era. Hereafter pathology, at least in the United States, could hope to develop symmetrically, utilizing for its advancement the materials and methods not of one branch of the science merely but of all branches, main and collateral, which being directed toward it might suffice to render a pathological phenomenon more comprehensible or afford the solution of a problem in medicine otherwise elusive.

The purpose when Welch was called to Baltimore was to proceed immediately with the selection not only of the staff for the Johns Hopkins Hospital but of the faculty of the medical school as well. Unforeseen economic conditions postponed the realization of the latter design; but as the hospital's resources had not been reduced by the unhappy accident which crippled the finances of the university, a clinical faculty was brought together. Welch's part in the choosing in 1888 and 1889 of Drs. Osler, Halsted and Kelly was conspicuous and decisive, just as later with the opening of the medical school in 1893 it was his acquaintance with their work and his unerring judgment of them as men which added to the distinguished trio Drs. Mall, Howell and Abel in the completion of the first major faculty of the Johns Hopkins Medical School. But Welch did not await the opening of the hospital or the consummation of the plan for a medical school to start active teaching and to get under way problems of research. Work was begun in an informal manner with medical graduates and advanced students in biology, and the quality of the material and the effects of Welch's influence can be gathered from the list of names of the first group to assemble under him. In it were Councilman, Mall, Nuttall, Abbott and Bolton. Before long this informal plan was superseded by systematic courses in pathology, including pathological histology and bacteriology, and university lectures. These were not permitted, however, to degenerate merely into short, superficial series of demonstrations, lectures and exercises; but they always carried with them the freshness of the unexpected from the wide variety of activities going on in the laboratory and also the incentive to individual endeavor when any new point arose exciting to some one's curiosity.

With the founding of the medical school along the lines now familiar but none the less at that time novel to the point of revolution, the break with the past was complete and the aspiration which for so long kept Welch a student and a teacher was to be realized, and in full measure. Henceforth medical education in the United States was to be on a basis equalling at least the best continental model. The faculty of the medical school was to lose its local and provincial character and to be representative of the most potent forces in the country, while the young men and women seeking to enter medicine were to possess a foundation training in physical, chemical and biological science and to be equipped so as to follow in the original tongues the greater scientific medical literatures of the French and the Germans. This was revolution indeed; but like all of Welch's reforming acts it was a program of construction not of destruction. Welch's career stands forth supreme as a force for advancement, whether in research, education, hospital organization or public health; but one searches in vain his writings or the records of his public utterances for evidence of vehemence or denunciation. His was too understanding and sympathetic a spirit to judge men and things harshly for faults and shortcomings, the origins of which were sunk deeply into a past whose circumstances were so unlike those of the present. He made use rather of the gentler art of persuasion by exposition and example, leavening now here and now there,

until the cumulative power of the intellectual and social ferment induced became so great as to be irresistible, and the whole mass was moved forward.

From the outset Welch was the central figure and guiding genius of the medical group. The pathological laboratory became an active center of research and teaching. Welch's life quickly became filled to overflowing. He conducted investigations of his own, launched others on productive themes, and saw to it that the invaluable pathological specimens from the surgeons and gynecologists were made use of to advance knowledge and train a generation of special pathologists in those important fields. He lectured on special and general subjects in pathology and bacteriology in a manner so learned and fascinating as to produce impressions not only immediately stimulating to his auditors in high degree but of enduring permanence. The suggestiveness of these lectures led frequently to new undertakings in research. Moreover, the autopsies he performed, his demonstrations of gross pathological specimens and his teachings at the microscope stand out as unsurpassable models. He entered also into the medical activities of Baltimore and of the state of Maryland, and became a great influence for betterment in private and public medicine. He was, of course, the first dean of the medical school and guided the policy of the new institution into the productive channels that have so eminently distinguished it. His many talents were therefore called into constant play, and heavily overtaxed as they must often have been there was never indication of exhaustion. When occasion arose he was always ready, eager and able for a new advance, as witness his leading part in the recent development of the full-time system, so-called, in the clinical branches of medical teaching, in establishing a model school of public health and hygiene, and in serving on scientific and philanthropic boards possessing great wealth, for promoting scientific discovery and for carrying the benefits of medical knowledge to the furthest parts of the world.

The achievements of Welch as an investigator, teacher and reformer in medicine are so many and varied that it is not possible to do justice to them in detail in a mere sketch. This is particularly true of that part of his career covered by the Baltimore and Johns Hopkins period. These three noble volumes of his collected papers and addresses are the best expression of his many-sided activities. And yet precious as they are, they afford no real insight into Welch's almost flawless personality, the depth of his friendship and wealth of his kindness, his faculty of intense application and devotion to the work in hand whether in laboratory or in public interest, his commanding influence and guiding spirit over the work of his associates and many pupils, the stimulating wholesomeness of his public activities, and his rarely unselfish and tolerant nature which led him to shower his great gifts prodigally and far and wide. The recipient of almost every honor in the gift of his colleagues, he fortunately, in time, saw the return of his labors, increased many-fold, enriching science through progress made in education, in deeds performed and discoveries by the men and institutions over whose destinies he had presided. And lastly these volumes fail to show us still another side of Welch's accomplishments as remarkable almost as those of the science we so love to laud in him. I refer to his culture outside the realm of medicine in the field of literature, in which he possesses an almost unerring taste for the best in poetry and prose, and in the domain of the fine arts. His mind is indeed stored with the beautiful creations of other men's minds from ancient times to our own day. It is to all these remarkable qualities, innate and acquired, united in one man, that we owe that thrice rare personality William Henry Welch, master in medicine and beloved of men.

SIMON FLEXNER

THE STRUCTURES OF THE HYDROGEN MOLECULE AND THE HYDROGEN ION

IN a letter to SCIENCE published June 18 I described a model for the helium atom which

is in better accord with the chemical relationships of helium than is the model proposed by Bohr. It leads to a value 25.59 volts for the ionizing potential in agreement with experimental determinations while Bohr's theory gives too high a value. In the model which I proposed the two electrons move in separate orbits in a plane containing the nucleus. The electrons are always symmetrically located with respect to a second plane which passes through the nucleus and is perpendicular to the plane of the orbits. Each electron thus oscillates back and forth along an approximately semi-circular path.

We may conceive of the hydrogen molecule as having a similar structure except that there are two nuclei. The electrons may thus move in separate orbits in a plane which is perpendicular to and bisects the line connecting the nuclei. The positions of the electrons at any time are symmetrical with respect to another plane which passes through both nuclei. Starting from two points on opposite sides of the center of the molecule, we may imagine the electrons to revolve about the center in opposite directions. After something less than a quarter revolution the electrons come so close to one another that the repulsive forces between them bring them both to rest. These forces then cause them to return back along the same paths to the starting points. They then continue their motion and complete another quarter of a cycle before they again come to rest. Each electron thus oscillates along a nearly semicircular line.

On the basis of the classical mechanics, by a series of approximations, it is possible to calculate the size and shape of the orbits and the relative velocities of the electrons at any point in their paths in terms of the distance between the nuclei. If we let a be the distance from the center of the molecule to the mid-point of the nearly semicurcular orbit of the electron, then the distance between the nuclei is $0.619 \times a$ and the radius vector of the electron at the ends of the orbit (where the electron comes to rest) is $1.152 \times a$. The angle through which the electrons move is 71° 26′ each side of the mid-point as measured from the center of the molecule. The angular velocity of the electrons at the mid-points of their paths is such that if they continued to move with this velocity they would travel through 106° 00′ during the time that they actually take to move to the end of the orbits (*i. e.*, through 71° 26′). The total energy (W) of the molecule (kinetic plus potential) is found to be $1.604 \frac{W_0 a_0}{a}$ where W_0 is the corresponding energy for the hydrogen atom according to Bohr's theory and a_0 is the radius of the electron orbit in the hydrogen atom (0.530×10^{-8} cm.).

It should be possible by means of the quantum theory to determine a, and fix the absolute dimensions of this model. But, so far as I know, the quantum theory has not yet been formulated in such a way that it can be applied with certainty to the type of motion that we are here considering. The quantum condition $\int pdq = nh$ is only valid when the co-ordinates are chosen in a particular manner, and for a case like the one in hand I have not been able to find any general method for determining what system of co-ordinates should be used. It may be, however, that others having greater familiarity with the recent mathematical development of the quantum theory will be able to determine the value of a for the model under consideration.

I have therefore proceeded to calculate the value of a from the known heat of dissociation of molecular hydrogen into atoms, and then to test this result by calculating other properties of hydrogen. Taking q the heat of dissociation (at constant volume), as 84,000 calories per gram molecule we find that $W/W = 2.270$. Since q is proportional to $W - 2W_0$ it takes a relatively large change in q to have much effect on the value of W. Thus an error of eight per cent. in determining the heat of dissociation (which is greater than the probable error), would cause only a one per cent. error in W and in a. From the relation previously given, we thus find $a = 0.707a_0 = 0.375 \times 10^{-8}$ cm. When the

electrons are at the ends of their orbits their distance from the center is 0.432×10^{-8} cm. In Bohr's model for the hydrogen molecule the radius of the orbit of the electrons is 0.953 a_0 or 0.506×10^{-8} cm. In the new model the distance of the nuclei from the center is 0.232×10^{-8} cm. while in Bohr's model this distance is 0.292×10^{-8} cm. The moment of inertia of the molecule about its center is thus 1.78×10^{-41} g. cm.^{2} for the new model while Bohr's model gives $2.81 \times^{-41}$ g. cm.^{2} From the theory of band spectra which has recently been developed by Lenz, Heurlinger and others it is possible to calculate the moment of inertia of the hydrogen molecule from certain relationships between lines of the secondary spectrum of hydrogen which were found by Fulcher and Croze. Thus Sommerfeld[1] calculates that the moment of inertia of the hydrogen molecule is 1.85×10^{-41}. This value agrees within four per cent. with that calculated from the new model (1.78×10^{-41}) while Bohr's model gives a value 52 per cent. too high.

It is of interest to enquire if there are not other simple models for the hydrogen molecule which are consistent with the known chemical facts regarding the remarkable stability of a pair of electrons in molecules. Sommerfeld has modified Bohr's original theory of atomic structure by considering elliptical as well as circular orbits. A two-quantum orbit of an electron in an atom may have both quanta in the form of angular momentum (circular orbit), or there may be one quantum of angular and one of radical momentum (elliptical orbit). Both quanta can not be in the form of radial momentum, for the ellipse would then degenerate into a straight line which would pass through the nucleus and this would lead to infinite velocities for the electron. This reason for the exclusion of orbits having only radial quanta fails for the case of a molecule in which there is no nucleus at the center. We should therefore consider models for the hydrogen molecule in which the two electrons oscillate in and out along a straight line passing through the center of the molecule, and perpendicular to the line joining the two nuclei. The repulsion of the electrons for each other would prevent them from reaching the center. We assume of course that the two electrons are coupled together by some quantum relationship, in such a way that they are always at equal distances from the center. If the electrons are at their greatest distance from the center they are more strongly attracted by the two nuclei than they are repelled from each other and they therefore fall in towards the center. When they get close to the center the repulsion increases rapidly and finally causes the electrons to rebound to their original positions. When the electrons are far apart there is a net repulsive force between the nuclei, but when the electrons are close together the attractive force on the nuclei predominates. The length of the path traveled by the electrons must be so related to the distance between the nuclei that the time averages of the repulsive and attractive forces acting on the nuclei must be equal.

By a series of approximations, based wholly on the classical mechanics, the following results have been calculated. If we take b. the distance between the center of the molecule and the nuclei as unity, the maximum distance reached by the electrons (from the center) is 3.710, while the minimum distance within which they approach the center is 0.1644. The electrons attain their greatest velocity when they are at a distance of 0.5773 from the center, and if they continued to move with this velocity they would travel a distance 8.989 in the time that it actually takes to move from the position of nearest approach to the point in the orbit furthest from the center. The total energy W of the molecule according to this model is 0.8124 $W_0 a_0/b$ where W_0 and a_0 have the same meanings as before.

In the absence of definite knowledge as to how to apply the quantum theory to this model we may calculate the absolute dimensions from the heat of dissociation. Taking

[1] "Atombau und Spectrallinien," p. 561, 2d edition, soon to be published.

as before $W = 2.270\ W_0$ we find for b, the distance from the nuclei to the center of the molecule, the value 0.190×10^{-8} cm. The moment of inertia is thus 1.20×10^{-41} g. cm.[2] Since this value does not agree at all well with the value 1.85×10^{-41} calculated from the spectrum it is improbable that this model corresponds to the true structure of the hydrogen molecule in its normal state. It may be however that such a model with a different value for b may apply to a disturbed state of the molecule.

According to Bohr's theory in which the paths of electrons are circular, a hydrogen ion consisting of two hydrogen nuclei with one electron, should not be capable of existing, for the value of W for such a structure ($0.88\ W_0$) is less than that for the hydrogen atom and the ion should therefore break up into an electron and a hydrogen atom. There seems to be considerable experimental evidence[2] that the positive H_2 ion is stable and is formed from ordinary molecular hydrogen when an ionizing voltage of about 11 volts is applied.

Since the H_2^+ ion has two nuclei there is no obvious necessity for assuming a circular path for the electron. I have therefore considered a model in which the electron oscillates along a rectilinear path passing through the center of the ion and perpendicular to the line joining the nuclei. By the methods of the classical mechanics it can be shown that if we take b, the distance between the center of the ion and the nuclei, as unity, then the maximum displacement of the electron from the center (*i. e.*, at the end of its path) is 2.214. The velocity of the electron when it passes the center of the ion is such that if it should continue to move with this velocity it would travel a distance 5.148 during the time that it actually takes to move from the center to the point furthest from the center. The total energy W of the ion is $0.6468\ W_0 a_0/b$. As soon as b is known the ionizing potential of hydrogen corresponding to this model can be calculated.

I have tried to apply the quantum theory in two different ways, although without certainty that either way is correct. According to the first method I have assumed that the angular momentum (or the moment of momentum) of the electron about each of the nuclei is $h/2\pi$ when the electron passes through the center. Of course the angular momentum about one of the nuclei decreases as the electron moves further from the center but this is due to the fact that the momentum is imparted to the other nucleus. A consideration of Landé's models for the octet, as well as the model which I previously proposed for the helium atom, suggests that in structures having more than one electron and one nucleus, we are concerned not with the momentum possessed by any electron, but rather with the momentum which is *transferred* from one electron to another or from an electron to a nucleus. On the basis of this assumption, it can be readily calculated that the value of b, the distance of the nuclei from the center, is $0.4250\ a_0$ or 0.225×10^{-8} cm. The energy of the ion is then $1.522\ W_0$. Since this is larger than that for the hydrogen atom, this ion will be stable. The difference between this energy and that for the hydrogen molecule (*i. e.*, $0.748\ W_0$) corresponds to the energy required for ionization. Expressed in volts this is 10.15 volts, which is in fair agreement with the experimental values (11 to 11.5 volts).

In the second method of applying the quantum theory I have used the relation $\int p dq = h$ where I have taken q to be the distance measured from the center along the rectilinear path, and p is the momentum in the direction of this path. As far as I know there is no good reason for choosing this particular coordinate system except that it seems to be the simplest. These assumptions lead to the value $b = 0.5261\ a_0 = 0.279 \times 10^{-8}$ cm. The energy is then $1.229\ W_0$, which again corresponds to a stable hydrogen ion but the ionizing potential is 14.1 volts.

The evidence in favor for these models is far from conclusive but in view of the fact that Bohr's models for the hydrogen molecule and ion can not be correct it seems important

[2] See particularly Franck, Knipping and Krüger, *Deut. Phys. Ges. Verh.*, 21, 728 (1919).

to test out the new models in as many ways as possible. The mathematical calculations upon which these models are based will probably be published in the *Physical Review*.

IRVING LANGMUIR

RESEARCH LABORATORY,
GENERAL ELECTRIC CO.,
SCHENECTADY, N. Y.,
October 13, 1920

SCIENTIFIC EVENTS

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

EDWIN S. CARMAN, manufacturer, of Cleveland, Ohio, has been elected president of the American Society of Mechanical Engineers in a mail ballot covering a membership of 13,000 engineers, managers and technologists in every industrial center of the country. Mr. Carman succeeds Major Fred J. Miller, of this city. He will take office after the society's annual convention, which will be held in New York in December.

John L. Harrington, consulting engineer, of Kansas City; Leon P. Alford, editor, of New York, and Robert B. Wolf, president of the R. B. Wolf Company, of New York, were chosen vice-presidents for two years in succession to John A. Stevens, of Lowell, Mass; Henry B. Sargent, of New Haven, Conn, and Fred R. Low, of this city.

Three managers, each for a term of three years, were elected, as follows: Henry M. Norris, of Cincinnati; Carl C. Thomas, of Los Angeles; Louis C. Nordmeyer, of St. Louis. Major William H. Wiley, publisher, of New York, was re-elected treasurer. The secretary will be elected by the society's council in December. Calvin W. Rice has held this office since 1906.

Following a meeting of the society's council, composed of the president, vice-presidents, managers, past presidents, treasurer and secretary, representing engineering effort in many sections of the country, and with a membership of twenty-one, broad plans for promoting professional endeavor and public service, particularly as to industrial relations and rewarding engineering achievement, were announced. The finance committee recommended a budget for the ensuing year of over $500,000.

The meetings and progress committee detailed plans for the annual convention of the society in New York in December and also announced plans for a congress of mechanical engineers to be held in Chicago next spring.

THE AMERICAN ORNITHOLOGISTS' UNION

THE thirty-eighth stated meeting of The American Ornithologists' Union will convene in Washington, D. C., November 9–11.

Headquarters will be at The Harrington, 11th and E Streets, N. W., four blocks from the U. S. National Museum. Owing to the crowded condition of hotels in Washington members intending to be present are urged to make reservations well in advance.

The public meetings will be held in the U. S. National Museum, from 10 A.M. until 4.30 P.M. each day.

The reading of papers will form a prominent feature of the meetings. All classes of members are earnestly requested to contribute, and to notify the secretary before November 1, as to the titles of their communications and the length of time required for their presentation, so that a program for each day may be prepared.

In addition to the usual social features there will be opportunities to visit various places of interest, including the National Zoological Park and the Library of Congress. Arrangements have been made for a special exhibit in the library, showing the development of zoological illustrations as applied to birds and original drawings and photographs of birds by American artists and photographers.

T. S. PALMER,
Secretary

1939 BILTMORE ST., N. W.,
WASHINGTON, D. C.

THE AMERICAN SOCIETY OF NATURALISTS

THE American Society of Naturalists will hold its thirty-eighth annual meeting at Chicago, under the auspices of the University of Chicago, beginning on Thursday, December

30. The program of Thursday morning will be devoted to papers contributed by members and invited guests; this program may be continued on Friday if of sufficient length. It is expected that problems of organic evolution will be the central theme of these papers. On Thursday afternoon will be held a symposium on "General physiology." The Naturalists' dinner will be given Thursday evening, and at its close Dr. Jacques Loeb will deliver the presidential address on the subject "On osmosis."

Headquarters of the society will be at the Congress Hotel, Michigan Boulevard and Congress Street, in conjunction with other biological societies. Rooms without bath for one person may be had for three to five dollars; rooms with bath for one person range from four to nine dollars, and for two persons from seven dollars up. Members desiring accommodations at headquarters are urged to make reservations early in order that there may be no disappointments.

A. Franklin Shull,
Secretary

University of Michigan,
Ann Arbor, Mich.

THE ASSOCIATION OF AMERICAN GEOGRAPHERS AT THE CHICAGO MEETING

The seventeenth annual meeting of the Association of American Geographers under the direction of the President, Professor Herbert E. Gregory, will be held at Chicago, on Thursday and Friday, December 30 and 31, and also Saturday, January 1. Through the courtesy of the department of geography of the University of Chicago, the meetings will be held in Rosenwald Hall, where facilities for use of illustrative materials are provided.

The morning sessions will open at ten o'clock and close at one o'clock; the afternoon sessions will run from two-thirty to five-thirty. On Thursday evening at eight o'clock there will be a round table conference on the policy of the association at the hotel; on Friday evening there will be an informal conference at the hotel on cooperation in geographic research.

By vote of the council there will be a joint meeting with the Ecological Society of America on Friday morning. The speakers from this Association will be Professors Henry C. Cowles and A. G. Ruthven; the speakers from the Ecological Society will be Drs. D. T. MacDougall and V. C. Shelford. The President's address will be given at the opening of the session on Friday afternoon, and will be followed by three invited papers on industrial geography, according to the decision of the council at the spring meeting.

The nominating committee, consisting of R. H. Whitbeck, chairman, R. DeC. Ward and J. W. Goldthwaite, presents the following nominations for officers for 1921.

President—Ellen Churchill Semple.
Vice-presidents—A. J. Henry, Curtis F. Marbut.
Secretary—Richard E. Dodge.
Treasurer—George B. Roorbach.
Councilor—Nevin M. Fenneman.

All interested in geography, or its allied subjects, are cordially invited to attend the meetings of the association.

Richard Elwood Dodge,
Secretary

Storrs, Connecticut,
October 20, 1920

THE DEPARTMENT OF CHEMISTRY OF THE OHIO STATE UNIVERSITY

The department of chemistry of The Ohio State University held a chemical symposium on Saturday, October 16, as one of its contributions to the celebration on the occasion of the semi-centennial of the founding of the university from October 13 to 16. The following program was presented by the alumni of the department:

"A brief history of the department of chemistry," by William McPherson, head department of chemistry, The Ohio State University.

"The organization of a chemistry department," by Winfred F. Coover, professor of chemistry, Iowa State College.

"A chemical attack upon the unsolved problem of human diabetes," by Dr. Edgar J. Witzemann, research chemist for the Otho Sprague Memorial Institute, Rush Medical College, University of Chicago.

"Problems in the petroleum industry," by Colonel George A. Burrell (formerly head of Research Division, Chemical Warfare Service, U. S. Army), now president, The Gasoline Recovery Co., New York City.

"The composition of automobile exhaust gas in reference to the ventilation of vehicular tunnels," by Major Arno C. Fieldner, research chemist, Bureau of Mines, Pittsburgh, Pa.

On Friday evening preceding the symposium, a banquet of one hundred and thirty alumni and former students of the department was held at the Hartman Hotel. Among the speakers on this occasion were: Mr. Frederick W. Sperr, Jr., The Koppers Co.; Dr. Benjamin T. Brooks, The Mathieson Alkali Works; Mr. Frank O. Clements, General Motors Research Corporation; Professor Charles W. Foulk, department of chemistry, The Ohio State University; Mr. Cole Coolidge, department of chemistry, Ohio State University; Mrs. Carl Gay, and Mrs. George W. Stratton.

DEDICATION OF THE EDWARD ORTON MEMORIAL LIBRARY

THE Edward Orton Memorial Library was dedicated on Saturday, October 16, the exercises forming a part of the semi-centennial celebration of the Ohio State University. Edward Orton was the first president of that institution, its professor of geology until 1899, and state geologist of Ohio from 1882 until his death in 1899. The library, named in his honor, is a gift of his son, Colonel Edward Orton, Jr. It is located in Orton Hall and was opened for use late in 1917. The absence of Colonel Orton because of his duties in the war department prevented a dedication at that time.

Dr. I. C. White, president of the Geological Society of America, spoke on the contributions of Dr. Orton to geology; Colonel Orton spoke on the Edward Orton Memorial Library and announced the presentation of a set of the *Alpine Journal* and of $500 and stated that he would give a like amount from time to time. A reception followed and later the guests were entertained at luncheon.

The books of this library consist chiefly of the university collection, the geological survey collection and the Prosser library. The rooms are well lighted and commodious and the furnishings and equipment are unsurpassed by those of any similar library in the country.

SCIENTIFIC NOTES AND NEWS

NOBEL prizes have been awarded to Dr. Jules Bordet, professor of bacteriology at Brussels, and Dr. August Krogh, professor of oceanography at Copenhagen.

PROFESSOR F. FRANCIS, professor of chemistry in the University of Bristol, has been elected a corresponding member of the Belgian Royal Academy of Medicine.

DR. P. V. WELLS is returning to the Bureau of Standards after completing his investigations on the stratification of thin soap films, which he has been carrying forward at the laboratory of Professor Perrin in Paris.

GEORGE C. WHIPPLE, Gordon McKay professor of sanitary engineering, has returned to Cambridge after an absence of eight months, during which he has been chief of the Division of Sanitation of the League of Red Cross Societies, with headquarters at Geneva, Switzerland. His term of service ended on October 1, when he became consulting sanitary engineer. During the month of May, Professor Whipple and others visited Roumania to make an inspection of the methods for combating typhus and cholera.

NEIL M. JUDD, curator of American archeology, United States National Museum, has returned to Washington after having spent the last five months in Utah, Arizona and New Mexico, engaged in archeological investigations for the Bureau of American Ethnology and the National Geographical Society.

ERNEST M. GRESS, Ph.D. (Pittsburgh, 1920), has been appointed botanist in the Pennsylvania Bureau of Plant Industry, Harrisburg. In connection with his other duties Dr. Gress will undertake the upbuilding of an extensive herbarium at Harrisburg.

A. C. BOYLE, JR., mining engineer, and professor at the University of Wyoming, has re-

signed from the university to accept the position of geologist with the Union Pacific R. R. Co., with headquarters in Omaha, Nebraska.

F. W. Lommen, formerly research chemist in the Sprague Memorial Institute, Chicago, is now research chemist with the National Carbon Company at Cleveland.

The *Proceedings* of the Washington Academy of Sciences records resignations from the scientific service of the government as follows: Mr. A. H. Taylor, of the photometer section of the Bureau of Standards, has accepted a position at the Nela Research Laboratory of the General Electric Company. Mr. F. H. Tucker, associate chemist at the Bureau of Standards, has taken up research work at the New York laboratories of the Chile Exploration Company. Mr. Reeves W. Hart has resigned from the Leather Section of the Bureau of Standards, to become research chemist at the Benicia tannery, California. Mayo D Hersey, chief of the Aeronautic Instrument Section of the Bureau of Standards, has taken the position of associate professor of properties of matter, in the department of physics of the Massachusetts Institute of Technology. He is succeeded at the bureau by Dr. F. L. Hunt. Dr. Harrison E. Patten has resigned from the Bureau of Chemistry, U. S. Department of Agriculture, to accept a position as chief chemist with the Provident Chemical Company of St. Louis, Missouri. Kenneth P. Monroe, of the color laboratory of the Bureau of Chemistry, has accepted a position at the Jackson Laboratory of E. I. du Pont de Nemours and Company, Wilmington, Delaware.

At the meeting of the American Philosophical Society on November 5 the program consists of an illustrated paper by the president of the society, Professor William B. Scott, on "The Astrapotheria, a remarkable group of prehistoric South American animals."

A general discussion on "The physics and chemistry of colloids, and their bearing on industrial questions," was arranged jointly by the Faraday Society and the Physical Society of London, on October 25. The discussion was presided over by Professor Sir W. H. Bragg, and was introduced by Professor Svedberg, of the University of Upsala.

Professor Leotta, of Rome, Dumas, of Paris, and S. Rossi, of Montevideo, have recently delivered scientific lectures in Vienna.

Arthur Searle, Phillips professor emeritus of astronomy at Harvard University, died at his home in Cambridge on October 23. Professor Searle, who was born in England in 1847 and graduated from Harvard in 1856, became assistant in the Harvard College Observatory in 1869, retiring from active service in 1912.

Professor Yves Delage, professor of zoology at the Sorbonne, Paris, died October 8, at sixty-six years of age.

Sven Leonhard Törnquist, Professor of geology at Lund, died on September 6 at the age of eighty years.

Dr. F. Hofmann, professor of hygiene at the University of Leipzig, has died at the age of seventy-seven years.

General William C. Gorgas, former surgeon general of the Army, left an estate valued at $20,500, according to the petition of the probate of his will filed by his widow, Mrs. Marie D. Gorgas. The estate includes a house at Chevy Chase, Md., and life insurance.

The dean of the medical faculty of the University of Paris has been authorized in the name of the university to accept from Mme. Auguste Klumpke, widow of Professor Dejerine, the gift of the pathologico-anatomic collection of Dr. Dejerine, as well as a fund yielding 100,000 francs annually. A museum of neurology, including a laboratory, will be established which will bear the name of the J. Dejerine Foundation

A Ramsay Memorial Fellowship of the value of £300 a year for three years has been founded by subscriptions received from the Swiss Government and from Swiss donors, through the good offices of Professor Ph. A. Guye, of Geneva. The first Fellow to be elected is M. Etienne Roux, of Vich (Vaud),

Switzerland, who has decided to work in the laboratories of Professor W. H. Perkin, at Oxford.

THE one hundred and fifth regular meeting of the American Physical Society will be held in Cleveland, at the physical laboratory of Case School of Applied Science on Friday and Saturday, November 26 and 27, 1920. Other meetings for the current season are as follows: December 28–31, Chicago; annual meeting, February 25–26, New York; April 22–23, Washington; time not determined, Pacific Coast section.

THE Society of Biology of Buenos Aires has become a branch of the Society of Biology of Paris.

UNIVERSITY AND EDUCATIONAL NEWS

THE University of Virginia, founded by Thomas Jefferson, is preparing to celebrate its centennial anniversary next June, when it is expected that the alumni and friends will present an endowment fund of three million dollars.

DR. FRANK BILLINGS, who is professor of medicine in the University of Chicago, has given his medical library valued at $25,000 to the university. It will form the nucleus of the clinical library of the Medical School and will be eventually housed in the Albert Merritt Billings Hospital.

THE mayor of Frankfurt has announced that an endowment of 1,500,000 marks has been made to the Frankfurt University by James Speyer, the New York banker, in memory of his deceased sister, Mrs. Eduard Beit Von Speyer.

DR. WALTER DILL SCOTT, professor of phychology in Northwestern University and president of the Scott Company, who during the war was director of the committee on personnel and colonel, U. S A., has been elected president of Northwestern University.

MR. R. T. HASLAM, of the National Carbon Company, Cleveland, Ohio, has become director of the School of Chemical Engineering Practice of the Massachusetts Institute of Technology.

SAMUEL L. BOOTHROYD has been appointed professor of astronomy and geodesy at Cornell University, to succeed Professor O. M. Leland. Professor Boothroyd's appointment takes effect in September, 1921, in order that he may spend the coming year at the Lick Observatory, Mount Hamilton, California.

WILLIAM BERTOLLET PLANK, superintendent of the United States Bureau of Mines Station, Birmingham, Alabama, has been appointed to the George B. Markle professorship of mining engineering at Lafayette College. Other new appointments in the Engineering School the current year are Morland King, of Union College, to be associate professor of electrical engineering, William S. Lohr, of Lancaster, to be associate professor of civil engineering, and Luther F. Witmer, of the United States Bureau of Standards, to be associate professor of metallurgy.

AT the University of Iowa the following promotions to full professorships have been made: James Newton Pearce, chemistry; Lee Paul Sieg, physics; Ewen Murchison McEwen, anatomy, and John Hoffman Dunlap, hydraulics and sanitary engineering.

AT the State University of Iowa, Dr. Dayton Stoner has been promoted from associate in zoology to assistant professor of zoology.

ON returning to New York on September 29 from a collecting trip in northern Norway, H. P. K. Agersborg, instructor in anatomy, Long Island College Hospital, was appointed assistant professor of zoology, at the University of Wyoming.

DR. ARDREY W. DOWNS has been appointed to the chair of physiology in the University of Alberta. Dr. Downs was formerly assistant professor of physiology at McGill University.

DR. GRIFFITH TAYLOR, physiographer in the Weather Service, Melbourne, has been appointed to a specially created position of asso-

ciate professor of geography in the University of Sydney.

DISCUSSION AND CORRESPONDENCE

VISIBLE SOUND WAVES

The following notes, written by Lieutenant Thomas T. Mackie, 123d Field Artillery, A. E. F., describe a phenomenon which must have been observed rarely, if ever before, and it seems to be very much worth while to put the circumstances on record.

On one or two occasions within recent years the occurrence of sound waves visible to the naked eye under peculiar atmospheric conditions has, I believe, been reported; yet the event is so unusual that I have been persuaded to describe a similar one which I witnessed at the front on the opening day of the Meuse-Argonne offensive.

During the days immediately preceding the attack my regiment moved into position in a wooded area opposite Montfaucon, characterized by the roughness of the terrain, a jumble of high hills cut up by narrow and deep valleys. The battery to which I belonged was sent into position at the head of one of these valleys, enclosed by very steep slopes, and having roughly the shape of a V with the open end to the south. Some four or five hundred yards to our rear and approximately on a line with the extremities of the arms of the V was a battery of six-inch rifles.

For several days the weather had been more or less rainy and wet, and the morning of September 26 found us covered by a very heavy bank of fog which entirely excluded the sun. Soon after the attack opened, I had occasion to go to the top of one of the hills which flanked our position, and at a certain definite level above the battery a very considerable disturbance in the fog was noticeable after each discharge of the heavy rifles behind me. The visibility was such that the flash of the discharge could not be seen, but each time before the report reached us a band of greater density was clearly visible in the fog, moving with great rapidity up the valley toward us in the form of an arc. Its arrival was simultaneous with that of the sound of the discharge. This arc of greater fog density was perhaps six feet from its anterior to its posterior edge, and of about the same depth. It followed closely an altitude of some sixty or seventy feet above the floor of the valley and was clearly visible from both above and below that plane, but no similar phenomena were visible in any other plane.

The recent researches of Professor D. C. Miller, and others have shown that the muzzle wave from a large gun carries in its front a narrow region of compression immediately followed by a relatively wide region of expansion. From the above account, it would appear that the air was saturated with water vapor at a particular level, and that the expansion in the wave produced a visible increase in the fog density, the effect disappearing immediately again, owing to the subsequent re-evaporation when the air regained its normal pressure and temperature. The conditions of the terrain were very favorable to the concentration of a great amount of energy into the wave-front, and this was probably assisted by a sound-mirage effect. The upper layers of air being warmer than the lower the sound wave-fronts would be so bent as to tend to keep the energy near the earth's surface. The "experiment" was thus being conducted under such circumstances and on such a scale as can not readily be reproduced in the laboratory, and would rarely occur anywhere.

Frederick A. Saunders
Jefferson Physical Laboratory,
Harvard University,
October, 1920

DRIFT BOTTLES AS INDICATING A SUPERFICIAL CIRCULATION IN THE GULF OF MAINE

In his "Explorations in the Gulf of Maine" H. B. Bigelow[1] has found evidence of a circulation of the water in the gulf. Since this evidence depends chiefly on the contours of the osohalines and the distribution of plankton, the direction and rate of movement of the drift bottles to be described, obtained incidentally in another investigation may be of importance in adding to this evidence. During the summer of 1919 as part of the hydrographic work in the Bay of Fundy by the Biological Board of Canada, 330 drift bottles were set out in the bay. Sixteen of these bottles have been picked up on the shores of the Gulf of Maine. The

[1] *Bull. Mus. Comp. Zool.*, Vol. 58, p. 29; Vol. 59, p. 149; Vol. 61, p. 163

distribution of the bottles which left the Bay of Fundy from two of these sets is shown in the figure, where the interrupted lines merely join the points of setting out and finding of the bottles, and are not intended necessarily to indicate the course which the bottle may have taken. The bottles were set out between June 18 and September 26 in sets spaced in lines across the bay at various distances from its entrance. Each bottle contained a Canadian postcard on which was printed besides the address of the Biological Station the offer of a reward to the finder who wrote the time and place of finding and posted the card. The bottles were of two kinds; two-ounce bottles and eight-ounce bottles; to the latter a galvanized iron drag was attached to hang at a depth of three fathoms, the object of the drag being to minimize the direct effect of the wind. Fifty-five of these latter bottles with drags were set out and six have been found and reported from outside the Bay of Fundy, to date (August 6, 1920). Three of these were picked up on the Cape Cod peninsula, the rest on the coast of Maine. Of the two hundred and seventy-five bottles without drags, ten have been reported from outside the bay. Eight of these ten were picked up on the Cape Cod peninsula, the other two on the coast of Maine. (See figure which shows only the bottles of the first two sets.)

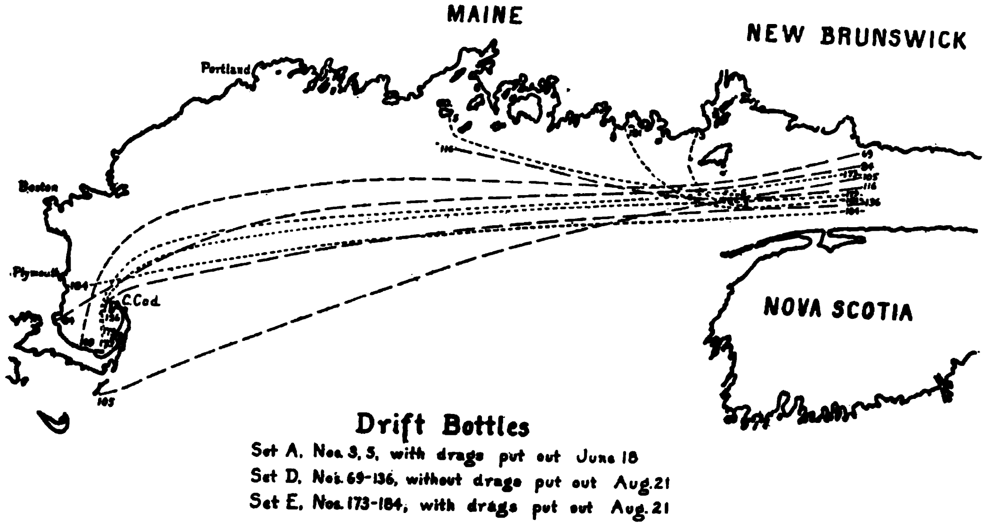


FIG. 1.

The times when the bottles were found are significant since they establish a minimum rate for the drift. Seven out of the eleven bottles which went to Cape Cod were found between 70 and 80 days after being put out, the shortest time being 73 days. The distance in a straight line from the Bay of Fundy is about 300 nautical miles. The rate of the drift was therefore about four nautical miles per day.

The drift of these bottles, set out at various times during the summer, indicates a surface movement of the water from the Bay of Fundy through the northwestern part of the Gulf of Maine and striking Cape Cod, the rate of this drift being about four nautical miles per day.

JAMES W. MAVOR

UNION COLLEGE

SCIENTIFIC BOOKS

La Vie Psychique des Insectes. Bibliothèque de Philosophie Scientifique. By C. L. BOUVIER. Paris, Ernest Flammarion, 1918. 299 pp.

In this interesting little volume Bouvier endeavors to present an up-to-date sketch of insect behavior. In the introduction he quotes the following remarkable passage from Maeterlinck's paper on Fabre and his work:[1]

The insect does not belong to our world. Other animals and even the plants, despite their mute lives and the great secrets they enfold, seem not to be such total strangers, for we still feel in them, notwithstanding all their peculiarities, a certain terrestrial fraternity. They may surprise or even amaze us at times, but they do not completely upset our thoughts. Something in the insects, however, seems to be alien to the habits, morals and psychology of our globe, as if it had come from some other planet, more monstrous, more energetic, more insensate, more atrocious, more infernal than our own. With whatever authority, with whatever fecundity, unequalled here below, the insect seizes on life, we fail to accustom ourselves to the thought that it is an expression of that nature whose privileged offspring we claim to be. . . . No doubt, in this astonishment and failure to comprehend, we are beset with an indefinable, profound and instinctive uneasiness, inspired by beings so incomparably better armed and endowed than ourselves, concentrations of energy and activity in which we divine our most mysterious foes, the rivals of our last hours and perhaps our successors. . . .

And Bouvier adds:

We have the feeling that the psychic evolution of these animals must be no less original than their structure and that they never differ so greatly from us as when they seem to resemble us most closely.

Bouvier's discussion of the psychic life of insects is divided into two parts, a "methodical" part, comprising Chapters I. to IX. and a "special" part, comprising the five concluding chapters. The methodical part treats of the tropisms, vital rhythms, differential sensibility, organic, specific and individual (associative) memory, the learning process, the modifications of habits, the evolution of instincts and in the ninth chapter of the comparative or historical method as illustrated by a single Hymenopterous family, the Psammocharidæ (Pompilidæ). Loeb and Bohn are at first rather rigidly followed, and the author is not very favorable to the position of Jennings. He attributes the "trial and error" activities to differential sensibility and even tries to use this as a partial explanation of "death feigning." But later his treatment of the problems of insect behavior broadens out and he reveals himself as a sane and catholic Neolamarckian, with strong eclectic tendencies and willing to utilize natural selection, Mendelism and mutationism in accounting for certain phenomena such as the sexual differences in instincts and the evolution of the worker and soldier castes in social insects. His general position is summarized at the end of the eighth chapter in the following paragraphs:

Owing to their tropisms, their rhythms, the adaptive manifestations of their differential sensibility, but especially their ability to transform habits into automatisms, the Articulates are essentially creatures of instinct, whose activities are largely made up of automatisms, but automatisms dominated by cerebral control ("puissance cérébrale"). They can not be regarded as simple "reflex machines," because they can adapt themselves to circumstances, acquire new habits, learn to remember, and manifest discernment. They might be regarded as somnambules, whose minds awake and give evidence of intelligence when the need is felt, and this takes us a long way beyond the mechanism of which Bethe has made himself the protagonist.

The activity of insects is characterized by two essential peculiarities: first, the presence of multiple, more or less perfectly adapted appendages, and second, the power very quickly to transform acts originally intelligent into automatic acts. This latter character is without doubt a consequence of the former, for the appendages are instruments both structurally and functionally almost congealed (figés). At any rate, there can be no doubt that this is the principal factor in the evolution of the Articulates. Owing to this peculiarity, in fact, the automatic activity of the animal can go on enriching itself with new elements borrowed from intelligence and thus adapted to new necessities. A substratum of activity is thus produced and develops, permitting intelli-

[1] *Ann. Polit. Lit.*, 2 Avril, 1911.

gence, as Bergson says, to mount on the wings of instinct. It does not soar far, nor very high, because its efforts very soon congeal in automatic form, but with each attempt the instinctive substratum is augmented to give the animal a vaster field of activity. Thus we reach the higher Articulates in which the most complex automatic activities, fringed with intelligence, become concatenated and purposive as if they had been regulated by reason. Hence we repeat here what we said at the beginning of the present work: The Articulates never differ so greatly from us as when they seem to resemble us most closely.

Chapter IX. on the behavior of the Pompilids, drawn very largely from the valuable researches of Pérez and his pupil Ferton, is admirably written and can be recommended to those who are inclined to underestimate the value of ethological and historical methods in comparative psychology. An even more interesting chapter could, however, be compiled from the literature on these solitary wasps. On page 161 Bouvier tells us that "it is unfortunate that no biologist up to the present time has been able to witness the oviposition of *Ceropales*," thus overlooking completely the very interesting observations of Adlerz[2] on the surreptitious oviposition of this parasite in the lung-books of the spiders that have been captured by the host Pompilid. The extraordinary habits of one of the American Pompilids, described by Needham and Lloyd in their "Life of Inland Waters," 1916, also deserve mention in such a chapter as the one under consideration. According to these authors,

There is a black wasp, *Priocnemis flavicornis*, occasionally seen on Fall Creek at the Cornell Biological Field Station, that combines flying with water transportation. Beavers swim with boughs for their dam, and water striders run across the surface carrying their booty, but here is a wasp that flies above the surface towing a load too heavy to be carried. The freight is the body of a huge black spider several times as large as the body of the wasp. It is captured by the wasp in a waterside hunting expedition, paralyzed by a sting adroitly placed, and is to be used for provisioning her nest. It could scarcely be dragged across the ground, clothed as that is with the dense vegetation of the waterside; but the placid stream is an open highway. Out on to the surface the wasp drags the huge limp black carcass of the spider and, mounting into the air with her engines going and her wings steadily buzzing, she sails across the water, trailing the spider and leaving a wake that is a miniature of that of a passing steamer. She sails a direct and unerring course to the vicinity of her burrow in the bank and brings her cargo ashore at some nearby landing. She hauls it up on the bank and then runs to her hole to see that all is ready. Then she drags the spider up the bank and into her burrow, having saved much time and energy by making use of the open waterway.

Additional peculiarities of habit among the Pompilids have been described by other authors, notably by F. X. Williams in a recent work on the wasps of the Philippines.[3]

In the second part of the work Bouvier discusses certain selected phenomena which have been long and intensively studied by entomologists, the relations of insects to flowers, the homing of bees, ants and other insects, parthenogenesis and the determination of sex among the Hymenoptera and social life among the Articulates. When we consider that the researches on all these subjects have resulted in vast accumulations of observations, often hidden away in inaccessible journals and monographs, and a most bewildering diversity of interpretations, the author deserves high praise for his brief, concise and orderly presentation. Inadequacy of treatment was unavoidable in many cases, as, *e. g.*, the omission of any consideration of the important experimental contributions of Brun (1914) to the subject of the orientation and homing of ants and other animals. Any adequate treatment of even a portion of insect ethology at the present time would, of course, require several volumes and would transcend the powers of any entomologist. Most readers will be delighted with Bouvier's book as it stands, with its lucid diction, its lack of dogmatic assertion, its kindly and

[2] Bik. K. Svensk. Vet. Akad. Hand., 1902.

[3] Bull. No. 14, Exper. Station Hawaiian Sug. Plant. Assoc., 1919.

stimulating tone and its frank acknowledgment of our ignorance in regard to many matters of fundamental importance. So valuable a work should have been printed on much better paper, but the exigencies of the war probably made this impossible. One could have wished also that the author had provided the volume with an index and had seen fit to give careful citations of the many interesting works to which he refers.

W. M. WHEELER

SPECIAL ARTICLES

ON THE PROTEIN CONTENT OF WHEAT

WHEATS of the Pacific coast states are conspicuously low in protein, so much so that western millers are obliged to ship in large quantities of high protein wheat to mix with their domestic wheats in order to manufacture flour of good baking qualities. The cause of the low protein content of western wheats has been the object of considerable investigation on the part of interested agronomists and plant physiologists for the last two decades. Results obtained from these investigations have led to a rather common belief, that the cause of the low protein content of Pacific coast wheat is primarily attributable to peculiar influences of climate.

In an investigation by the writer on the effect of applications of certain forms of soluble nitrogen to plants at different growth phases, results obtained with wheat, one of the plants studied, throw new light upon this protein question. In this paper, only that part of the plan and the results that pertain to the subject under discussion, need be given. These are essentially as follows:

Glazed stone jars were filled with a soil very low in nitrogen. This soil, as taken from the field, had a very low crop-producing power when cereals were planted, but upon receiving a moderate application of soluble nitrogen salt would yield large crops. This soil was planted to a pure strain of White Australian Wheat. Two hundred and fifty milligrams of nitrogen per jar, that is, at the rate of 100 pounds of nitrogen per acre, were added in single applications to different jars, at different times during the growng period of the plants. The nitrogen was added in two forms, $NaNO_3$ and $(NH_4)_2SO_4$, respectively, for two different series that were tested. Every application was made in triplicate. The first application of nitrogen to the first set of triplicates of each of the two series was made at the time of planting, the second was made to other jars 17 days after planting and so on at intervals until the last sets in each of the $NaNO_3$ and $(NH_4)_2SO_4$ series received their nitrogen application 110 days after planting. Every application of nitrogen made to the several sets in the series was, therefore, made at different ages of the plants and obviously represents more or less different growth phases of the plants. The tabulated data for a $NaNO_3$ series will serve as an example of the plan of the investigation and gives the results obtained.

EFFECT OF $NaNO_3$ APPLICATIONS ON THE PROTEIN CONTENT OF SPRING WHEAT APPLIED AT DIFFERENT GROWTH PHASES OF THE PLANTS

Results Average of Triplicate Jars

Date of Planting	Date of Nitrogen Application	Days After Planting When Nitrogen was Applied	Yield of Grain Grams	Commercial Grade	Per Cent. Crude Protein
11/14/19.	11/14/19		9.4	2 Soft white	8.6
11/14/19.	12/1/19	17	10.6	2 " "	9.3
11/14/19.	12/16/19	33	21.0	1 " "	10.4
11/14/19.	1/1/20	48	19.9	2 Hard	11.8
11/14/19.	1/24/20	72	21.9	1 "	13.2
11/14/19.	3/2/20	110	13.1	1 "	15.2

It will be noted that the data show a decided increase (about 77 percent.) in the protein content of wheat obtained from the plants that received nitrogen when they were 110 days old over those that were treated with nitrate at the time of planting. The protein content of the wheat obtained from these two different treatments are respectively 15.2 per cent., and 8.6 per cent. The data show that for each of the different applications of nitrate made after the time of planting, there was a corresponding increase in the protein content of wheat. As these increases in the

protein content of wheat correspond with the length of the period of the different deferred applications of nitrate made after planting, this would indicate a significant relation between the state of development of the plant and when nitrate can be most effectively utilized by the plant in the production of high protein wheat. This emphasizes that the physiological status of the plant, as indicated in its different growth phases, is a factor of great importance in the utilization of plant food available to it.

Not only was the protein content of the wheat increased by all of the deferred applications of nitrogen, but the yield of produce, excepting that obtained by the latest application, was much larger from the plants that received nitrogen for the period of 33 to 72 days after planting than those that received nitrogen during the early growing period. The best quality wheat as determined by commercial grading was secured from the plants that received nitrogen 72 and 110 days after planting. This means that the high protein wheat berry was likewise plump and well filled.

A much fuller account of the investigation with ample analytical data and a critical review of other investigations relating to the subject will shortly appear. It is felt that the results obtained in this investigation do show that the low protein content of Pacific states wheats is not due primarily to the climate as such, but so far as the investigation with this one soil is concerned, is due to insufficiency of available nitrogen at certain growth periods of the plants. That climate is not without effect upon the availability of the plant food in the soil is obvious, but the emphasis to be laid on the climatic complex is that it affects the nutrition of the plant. This can be both in the kind and quantity of each of the different nutrients that may be available to it. That this availability is an important factor in affecting the composition of plant products is shown by the results of this investigation.

W. F. GERICKE

UNIVERSITY OF CALIFORNIA

THE VITAMINE REQUIREMENTS OF THE RAT ON DIETS RICH IN PROTEIN, CARBOHYDRATE, AND FAT RESPECTIVELY[1]

IN 1913, one of us (C.F.) showed that the onset of the symptoms of beriberi in pigeons could be hastened by increasing the amount of polished rice fed. This led to the conclusion that the anti-beriberi vitamine—vitamine B—plays an important rôle in carbohydrate metabolism. This observation was confirmed shortly afterwards by Braddon and Cooper and others, although Eijkman and Vedder have denied the validity of this finding.

In a second series of experiments, in which the diets varied as shown in Table I., it will be noticed that beriberi developed in the following order: starch, sugar, casein, and fat.

TABLE I

Diet	Starch, Per Cent.	Sugar, Per Cent.	Casein, Per Cent.	Fat, Per Cent.	Salts, Per Cent.	Onset of Beri-beri, Days
Starch...	60	12	12	12	4	24
Sugar....	12	60	12	12	4	28
Casein...	12	12	60	12	4	30
Fat......	12	12	12	60	4	40

In order to check up the results obtained with pigeons in another class of animals, and also with the idea of attempting to throw some light on the prevailing view as to the importance of proteins of high biological value on the etiology of pellagra and war edema, analogous experiments have been carried out on rats. The composition of the diets and the results obtained are shown in Tables II. and III.

TABLE II

Diet[2]	Meat, Gm.	Sugar, Gm.	Starch, Gm.	Lard, Gm.	Salts, Gm.	Autolyzed Yeast, Cc.	Orange, Cc.	Agar, Gm.	Cod-liver Oil, Cc.
Meat	49	12	12	12	3	4	3	3	5
Sugar	12	49	12	12	3	4	3	3	5
Starch	12	12	49	12	3	4	3	3	5
Lard............	12	12	12	49	3	4	3	3	5

[1] From the Research Laboratory of H. A. Metz.

[2] The meat, sugar, starch, and lard were tested and found to be free from Vitamine B.

TABLE III

Diet	Weight—First 25 Days		Weight—Following 55 Days		Total Weight Increase, Per Cent.[3]
	Increase, Per Cent.	Decrease, Per Cent.	Increase, Per Cent.	Decrease, Per Cent.	
Meat	43	–	86	–	129
Sugar	15	–	55	–	70
Sugar and vitamine[4]	15	–	145	–	160
Starch	6	–	62	–	68
Starch and vitamine[4]	6	–	165	–	171
Lard	–	9	—	8	−17
Lard and vitamine[4]	–	9	34	–	25

The rats on the protein diet did not require the addition of extra vitamine (autolyzed yeast) at all. This may be regarded as the "sparing action of protein on the vitamine requirement." On the other hand, the rats on the fat diet took the extra vitamine with great avidity, but showed only a small advantage over the controls. The replacement of some of the fat by butter was without any significance, no improvement being noted.

On the starch diet, the rats actually needed extra vitamine (about 2 c.c. per day) in order to resume growth. This was likewise true of the rats on the sugar diet except that they appeared not to require as much vitamine for growth as those on the starch diet. On these diets we occasionally observed sudden large increases and losses in weight, suggestive of edema, though no external evidence was seen. As regards the general appearance of the animals, those on the protein diet and those getting extra vitamine looked very healthy, while the others appeared to be in poor shape with the usual evidences of improper nutrition. The rats on the high fat diet, without extra vitamine, presented the poorest appearance.

Out of thirty rats, only one developed keratomalacia, and this rat was getting five per cent. cod-liver oil. The eye condition cleared up on giving autolyzed yeast (about 2 c.c. per day).

The findings reported here show conclusively that although the qualitative food requirements of a well balanced diet have been pretty well established, this can not be said of the quantitative relationship between the dietary constituents necessary for proper nutrition. It is quite conceivable that under the abnormal conditions existing durng the war period and after, the usual ratio between the protein, carbohydrate, and vitamine constituents have been so changed as to present conditions analogous to those described by us in rats.

Theoretically at least, the above conditions could be corrected in either of two ways—(*a*) by increasing the protein and decreasing the carbohydrate intake, or (*b*) by supplying extra vitamine. The curative experiments of edema in rats reported by Miss Kohmann, and also the condition described as pellagra in a monkey, by Miss Chick, may be viewed in the above light. In view of the complications presented by the "sparing action of animal protein on the vitamine requirements," it may be just as well for the present to leave the question open, as to whether or not pellagra and war edema are avitaminoses. Of all the theories regarding pellagra, that expressed by Goldberger in which he states the facts and leaves the matter open for further investigation, appears to us to be the most satisfactory.

Our complete results will be published in detail later on.

Casimir Funk,
Harry E. Dubin

[3] In this instance, the figure represents the increase after 60 days, and is practically the same after 80 days, since most of the animals had already attained full size.

[4] Vitamine given during last 55 days.

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

Friday, November 12, 1920

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE PROTEINS AND COLLOID CHEMISTRY[1]

I

The proteins, like certain other constituents of protoplasm, are colloidal in character, *i. e.*, they are not able to diffuse through animal membranes which are permeable to crystalloids. For this reason a number of authors have tried to explain the behavior of proteins from the viewpoint of the newer concepts of colloid chemistry. Foremost among these concepts is the idea that the reactions between colloids and other bodies are not determined by the purely chemical forces of primary or secondary valency but follow the rules of "adsorption." Although a number of authors, during the last twenty years, *e. g.*, Bugarszky and Liebermann, Hardy, Pauli, Robertson, Sörensen, and others, have advocated a chemical conception of the reactions of proteins, their experiments failed to convince the other side since these experiments could just as well be explained on the basis of the adsorption theory. There were two reasons for this failure. First, the experiments did not show that ions combined with proteins in the typical ratio in which the same ions combine with crystalloids. This proof only became possible when it was recognized that the hydrogen ion concentration of the protein solution determines the amount of ion entering into combination with a protein, and that therefore the ratios in which different ions combine with proteins must be compared for the same hydrogen ion concentrations. Since the former workers were in the habit of comparing the effects of

[1] Address delivered before the Harvey Society, October 16, 1920. The writer's experiments, on which this address is based, have appeared in the *J. Gen. Physiol.*, 1918–19, I., 39, 237, 363, 483, 559; 1919–20, II., 87; 1920–21, III., 85.

the same quantities of acid or alkali added instead of comparing the behavior of proteins at the same hydrogen ion concentration they were not able to furnish the final proof for the purely chemical character of the combinations between ions and proteins, and nothing prevented chemists from assuming that proteins formed only adsorption compounds with acids, bases, and neutral salts.

The second reason for the failure to prove the purely chemical character of the protein compounds lay in the so-called Hofmeister series of ion effects. Hofmeister was the first to investigate the effects of different salts on the physical properties of proteins, and he and his followers observed that the relative effects of anions on the precipitation, the swelling, and other properties of proteins was very definite and that the anions could be arranged in definite series according to their relative efficiency, the order being independent of the nature of the cation. Similar series were also found for the cations, though these series seemed to be less definite. These Hofmeister series were a puzzle inasmuch as it was impossible to discover in them any relation to the typical combining ratios of the ions, and this lack of chemical character in the Hofmeister series induced chemists to explain these series on the assumption of a selective adsorption of these ions by the colloids.

To illustrate this we will quote the order which, according to Pauli, represents the relative efficiency of different acids on the viscosity of blood albumin,

HCl > monochloracetic > oxalic > dichloracetic > citric > acetic > sulfuric > trichloracetic acid,

where HCl increased the viscosity most and trichloracetic or sulfuric least. In this series the strong monobasic acid HCl is followed by the weak monochloracetic acid, this is followed by the dibasic oxalic acid; later follows a weak tribasic citric acid, then the very weak monobasic acetic acid, then the strong dibasic sulfuric acid, and finally again a monobasic acid, trichloracetic. Pauli is a believer in the chemical theory of the behavior of proteins but it is impossible to harmonize his series of anions with any purely chemical theory of the behavior of proteins.

The ion series of Hofmeister are no more favorable for a chemical conception. Thus, according to Hofmeister, gelatin swells more in chlorides, bromides and nitrates than in water, while in acetates, tartrates, citrates, or sugar it swells less than in water. R. Lillie arranges ions according to their depressing effect on the osmotic pressure of gelatin solution in the following way,

$$Cl > SO_4 > NO_3 > Br > I > CNS.$$

These series again betray no relation to the stoichiometrical properties of the ions. As long as these Hofmeister ion series were believed to have a real existence it seemed futile to decide for or against a purely chemical theory of the behavior of colloids since even with a bias in favor of a chemical theory the Hofmeister series remained a puzzle.

The writer believes to have removed these difficulties by using protein solutions of the same hydrogen ion concentration as the standard of comparison. In this way he was able to show that acids, alkalies, and neutral salts combine with proteins by the same chemical forces of primary valency by which they combine with crystalloids, and that, moreover, the influence of the different ions upon the physical properties of proteins can be predicted from the general combining ratios of these ions. The so-called Hofmeister series have no real existence, being the result of the fact that the older workers failed to measure the most important variable in the case, namely the hydrogen ion concentration of their protein solutions, a failure for which they can not be blamed since the methods were not sufficiently developed.

II

Pauli and a number of other workers assume that both ions of a neutral salt are adsorbed simultaneously by non-ionized protein molecules. If we consider the hydrogen ion concentration of the proteins we can show

that only the cation or only the anion or that neither ion can combine at one time with a protein; and that it depends solely on the hydrogen ion concentration of the solution which of the three possibilities exists.

Proteins exist in three states, defined by their hydrogen ion concentration, namely, (*a*) as non-ionogenic or isoelectric protein, (*b*) metal proteinate (*e. g.*, Na or Ca proteinate), and (*c*) protein-acid salts (*e. g.*, protein chloride, protein sulfate, etc.). We will use gelatin as an illustration. At one definite hydrogen ion concentration, namely $10^{-4.7}$ N (or in Sörensen's logarithmic symbol at $pH = 4.7$), gelatin can combine practically with neither anion nor cation of an electrolyte. At a $pH > 4.7$ it can combine only with cations (forming metal gelatinate, *e. g.*, Na gelatinate), at a $pH < 4.7$ it combines with anions (forming gelatin chloride, etc.). This was proved in the following way: Doses of 1 gm. of finely powdered commercial gelatin (going through sieve 60 but not through 80), which happened to have a pH of 7.0, were brought to a different hydrogen ion concentration by putting them for 1 hour at about 15° C. into 100 c.c. of HNO_3 solutions varying in concentration from M/8192 to M/8. After this they were put on a filter, the acid being allowed to drain off, and were washed once or twice with 25 c.c. of cold water (of 5° C. or less) to remove remnants of the acid between the granules of the powdered gelatin. These different doses of 1 gm. of gelatin now possessing a different pH were all put for 1 hour into beakers containing the same concentration, *e. g.*, M/64, of silver nitrate at a temperature of 15° C. They were then put on a filter and washed 6 or 8 times each with 25 c.c. of ice cold water; the wash water must be cold since otherwise the particles will coalesce and the washing will be incomplete. This washing serves the purpose of removing the $AgNO_3$ held in solution between the granules, thus allowing us to ascertain where the Ag is in combination with gelatin and where it is not in combination, since the Ag not in combination with gelatin can be removed by the washing while the former can not, or at least only extremely slowly by altering the pH. After having removed the $AgNO_3$ not in combination with gelatin by washing with ice cold water we melt the gelatin by heating to 40° C., adding enough distilled water to bring the volume of each gelatin solution to 100 c.c., determine the pH of each solution potentiometrically or colorimetrically, and expose the solutions in test-tubes to light, the previous manipulations having been carried out in a dark room (with the exception of the determination of pH, for which only part of the gelatin solution was used). In 20 minutes all the gelatin solutions with a $pH > 4.7$, *i. e.*, from pH 4.8 and above, become opaque and then black, while all the solutions of $pH < 4.7$, *i. e.*, from 4.6 and below, remain transparent even when exposed to light for months or years. The solutions of pH 4.7 become opaque, but remain white, no matter how long they may have been exposed to light. At this pH—the isoelectric point—gelatin is not in combination with Ag, but it is insoluble. Hence the cation Ag is only in chemical combination with gelatin when the pH is > 4.7 At pH 4.7 or below gelatin is not able to combine with Ag ionogenically. This statement was confirmed by volumetric analysis.

The same tests can be made for any other cation the presence of which can be easily demonstrated. Thus when powdered gelatin of different pH is treated with $NiCl_2$ and the $NiCl_2$ not in combination with gelatin be removed by washing with ice cold water, the presence of Ni can be demonstrated in all gelatin solutions with a $pH > 4.7$ by using dimethylglyoxime as an indicator. All gelatin solutions of pH of 4.8 or above assume a crimson color upon the addition of dimethylglyoxime, while all the others remain colorless. When we treat gelatin with copper acetate, and wash afterwards, the gelatin is blue and opaque when its pH is 4.8 or above, but is colorless and clear for $pH < 4.7$. Most striking are the results with basic dyes, *e. g.*, basic fuchsin or neutral red, after sufficient washing with cold water; only those gela-

tin solutions are red whose pH is above 4.7, while the others are colorless.

On the acid side of the isoelectric point, *i. e.*, at pH < 4.7, the gelatin is in combination with the anion of the salt used. This can be demonstrated in the same way by bringing different doses of powdered gelatin to different pH and treating them for one hour with a weak solution of a salt whose anion easily betrays itself, *e. g.*, M/128 $K_4Fe(CN)_6$. If after this treatment the powdered gelatin is washed six times with cold water to remove the $Fe(CN)_6$ not in chemical combination with gelatin and if 1 per cent. solutions of these different samples of gelatin are made, it is found that when the pH is < 4.7 the gelatin solution turns blue after a few days (due to the formation of ferric salt), while solutions of gelatin with a pH of 4.7 or above remain permanently colorless. Hence gelatin enters into chemical combination with the anion $Fe(CN)_6$ only when pH is < 4.7. The same can be demonstrated through the addition of ferric salt when gelatin has been treated with NaCNS, the anion CNS being in combination with gelatin only where the pH is < 4.7. Acid dyes, like acid fuchsin, combine with gelatin only when pH is < 4.7.

In this way it can be shown that when the pH is > 4.7 gelatin can combine only with cations; when pH is < 4.7 it can combine only with anions, while at pH 4.7 (the isoelectric point) it can combine with neither anion nor cation. The idea that both ions influence a protein simultaneously is no longer tenable.

It follows also that a protein solution is not adequately defined by its concentration of protein but that the hydrogen ion concentration must also be known since each protein occurs in three different forms—possibly isomers—according to its hydrogen ion concentration.

In the experiments just discussed it was necessary to wash the powdered gelatin to find out at which pH an ion was in combination with the gelatin. This has led some authors to the belief that in all my experiments the washing was a necessary part of the procedure. I therefore will call especial attention to the fact that the experiments to be described in the rest of the paper were carried out with isoelectric gelatin to which just enough acid or alkali was added to bring it to the hydrogen ion concentration required for the purpose of the experiment.

III

When a protein is in a salt solution, *e. g.*, NaCl, it will combine with Na forming sodium proteinate as soon as the pH is higher than the isoelectric point of the protein; when, however, the pH falls below that of the isoelectric point of the protein the Na is given off and protein chloride is formed.

Moreover, the writer has been able to show by volumetric analysis that the quantity of anion or cation in combination with the protein is an unequivocal function of the pH. When we add HCl to isoelectric gelatin and determine the pH we always find the same amount of Cl in combination with a given mass of originally isoelectric gelatin for the same pH; so that if we know the pH and the concentration of originally isoelectric gelatin present we can also tell how much Cl is in combination with the protein for this pH. The same is true when we add an alkali to the isoelectric gelatin. For the same pH the amount of cation in combination is always the same. These facts have led the writer to propose the following theory. When we add an acid, *e. g.*, HCl, to isoelectric gelatin (or any other isoelectric protein) an equilibrium is established between free HCl, protein chloride, and non-ionogenic or isoelectric protein; when we add alkali an equilibrium is established between metal proteinate, non-ionized protein, and the hydrogen ions. Sörensen was led to a similar view on the basis of entirely different experiments.

IV

This fact that the hydrogen ion concentration of a protein solution determines the quantity of protein salt formed is the basis on which the following proof for the purely chemical character of the combination be-

tween proteins and other bodies rests. The experiments mentioned thus far in this paper do not yet allow us to decide whether the ions are "adsorbed" or in chemical combination with the proteins. We will now show that acids and bases combine with proteins and an alkali. This can be proved in the following way. We know that a weak dibasic or tribasic acid gives off one hydrogen ion more readily than both or all three; while in a strong dibasic acid, like H_2SO_4, both hydrogen ions are held with a sufficiently small

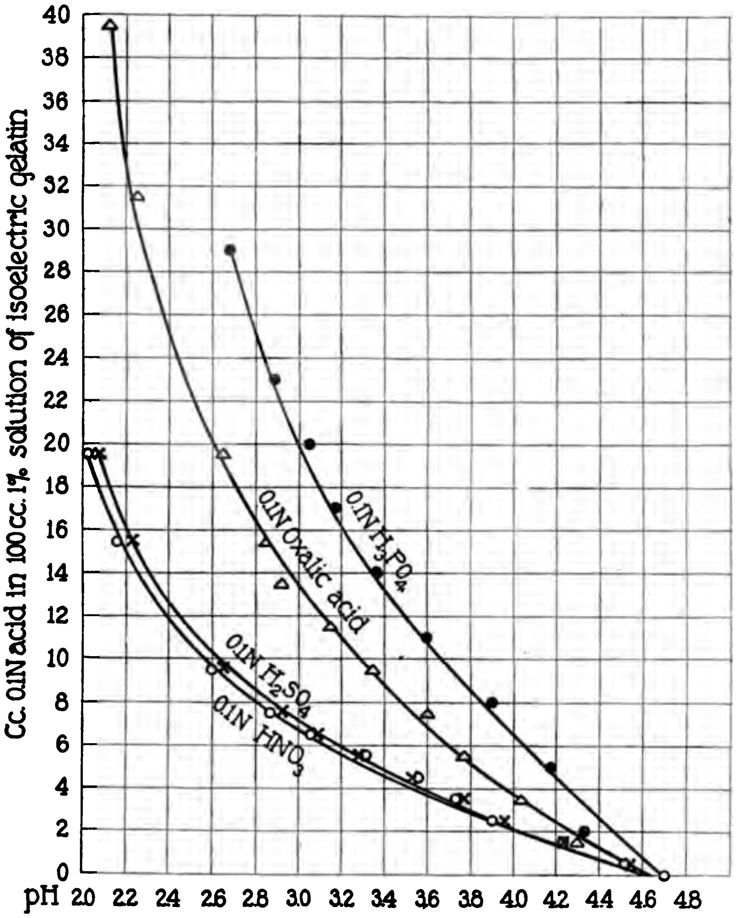


FIG. 1. The ordinates represent the c.c. of 0.1 N acid in 100 c.c. of 1 per cent. solution of isoelectric gelatin required to bring the solution to the pH indicated in the abscissæ. The curves for 0.1 N H_2SO_4 and 0.1 N HNO_3 are identical while the values for H_3PO_4 and oxalic acid differ, being approximately in the ratio of HNO_3: oxalic acid: H_3PO_4 as 1 : 2 : 3.

in the same way as they combine with crystalline compounds, namely by the purely chemical forces of primary valency. The combination between acids and proteins is analogous to that between acids and NH_3, and the combination between bases and proteins is analogous to that between CH_3COOH electrostatic force to be easily removed. If the forces which determine the reaction between these acids and proteins are purely chemical it would follow that three times as many c.c. of 0.1 NH_3PO_4 are required to bring 100 c.c. of 1 per cent. solution of isoelectric gelatin to a given pH, *e. g.*, 3.0, as are re-

quired in the case of HNO_3 or HCl; while twice as many c.c. of 0.1 N oxalic as of HNO_3 should be required. On the other hand, it should require just as many c.c. of 0.1 N H_2SO_4 as HNO_3. Fig. 1 shows that this is the case. The ordinates of this figure are the c.c. of 0.1 N acid required to bring 1 gm. of isoelectric gelatin to the pH indicated in the abscissae by the four acids mentioned, namely HNO_3, H_2SO_4, oxalic and phosphoric acids. The curves for H_2SO_4 and HNO_3 are identical while, for the same pH, the value for H_3PO_4 is always approximately three times and the value for oxalic acid is always approximately twice as high as for HNO_3.

On the basis of the same reasoning as applied to acids we should expect that equal numbers of c.c. of 0.1 N $Ca(OH)_2$ and $Ba(OH)_2$ as of LiOH, NaOH, and KOH should be required to bring 100 c.c. of a 1 per cent. solution of isoelectric gelatin to the same pH and the writer was able to show that this is the case. Similar results were obtained with crystalline egg albumin.

When we have a solution of a gelatin-acid salt of originally 1 per cent. isoelectric gelatin and of a certain pH, *e. g.*, 3.0, we have free acid in the solution and a certain amount of the anion of the acid in combination with gelatin. We can find out by volumetric analysis how much of the anion is in combination with the protein by making certain corrections discussed in former papers. In this way it can also be ascertained that all weak dibasic acids combine in molecular proportions with isoelectric protein, while strong dibasic acids and diacidic alkalies combine in equivalent proportions with proteins, as is shown by Table I. It follows from this table that for the same pH the amount of HNO_3, oxalic, and phosphoric acids in combination with the same quantity of originally isoelectric gelatin is always in the proportion of 1:2:3.

TABLE I

C.c. of 0.01 N Acid in Combination with 10 c.c. of a 1 Per Cent. Gelatin Solution at Different pH

pH	3.1	3.2	3.3	3.4	3.5	3.7	3.9	4.1	4.2	4.3
HNO_3 ...	4.35	4.1	3.6	3.2	2.85	2.45	1.9	1.45		0.75
Oxalic acid	9.6	8.75	7.6	6.7	6.00	4.3	3.0		1.65	
H_3PO_4 ...		12.4	10.4	9.8	9.00	7.4	5.8	4.5	2.6	2.1

We can therefore state that the ratios in which ions combine with proteins are identical with the ratios in which the same ions combine with crystalloids. Or in other words, the forces by which gelatin and egg albumin (and probably proteins in general) combine with acids or alkalies are the purely chemical forces of primary valency.

V.

The most important fact for our purpose is that from the combining ratios just mentioned the influence of acids and bases on the physical properties of proteins can be predicted. This influence is altogether different from that stated in the so-called Hofmeister series of ions or by the ion series of Pauli and his collaborators, and this difference is due to the fact that these latter authors compared the effects of equal quantities of acids or alkalies while we found it necessary to compare the physical properties of solutions of proteins of the same hydrogen ion concentration. If this is done the following rule is found. All those acids whose anion combines as a monovalent ion raise the osmotic pressure, viscosity, swelling of protein about twice as much as the acids whose anion combines as a bivalent anion for the same pH. The same valency rule holds for the cations of different alkalies.

We have seen that at the same pH three times as many c.c. of 0.1 N H_3PO_4 as of HNO_3 are in combination with 1 gm. of originally isoelectric gelatin in 100 c.c. of solution. It follows from this that the anion of gelatin phosphate is the monovalent ion H_2PO_4 and not the trivalent anion PO_4. It follows likewise from the combining ratios discussed that the anion of oxalic acid in combination with protein is the monovalent anion HC_2O_4. The same is true for all weak dibasic or tribasic acids, namely that they combine with proteins forming protein salts with monovalent anion. It follows also from the combining

ratios that the salt of a protein with a strong dibasic acid, as H_2SO_4, however, must have a divalent anion, *e. g.*, SO_4. If we compare the viscosity or osmotic pressure of 1 per cent. solutions of originally isoelectric gelatin with different acids of the same pH we find that these properties are identical for all gelatin salts with monovalent anion; in other words, 1 per cent. solutions of gelatin chloride, bromide, nitrate, tartrate, succinate, citrate, or phosphate have all the same viscosity, and the same osmotic pressure at the same pH. The same is true for the swelling (Fig. 2). If we plot the curves for these three properties with pH as abscissæ and the values for osmotic pressure, viscosity, and swelling as ordinates, we get practically identical curves for gelatin chloride, bromide, nitrate, tartrate, succinate, citrate, and phosphate. The values for swelling are a minimum at pH 4.7 (the isoelectric point of gelatin) they rise rapidly with the fall of pH until they reach a maximum at pH about 3.2, and then they drop again. Each curve is the expression of an individual experiment. The maximum in the curves for gelatin chloride, bromide, nitrate, tartrate, succinate, citrate and phosphate is practically identical, the variations between the values for these acids lying within the limit of variation which we may expect if we plot six different experiments with the same acid. When, however, we plot the same curves for gelatin sulfate, we get curves which are considerably lower, reaching a height of only one half (or a little less than) those of gelatin-acid salts with monovalent anions. It may be of interest to compare our curves with those expected on the basis of Pauli's and Hofmeister's ion series. According to the latter theory the curves for phosphates, oxalates, citrates, and tartrates should be in the region of the SO_4 curve but not in the region of the Cl curve. Those authors who observed such differences did not measure the hydrogen ion concentration, attributing the effects due to the difference in the hydrogen ion concentration of their gelatin solutions erroneously to a difference in the anion effect. These elementary errors form the basis of a number of speculations current in biology and pathology.

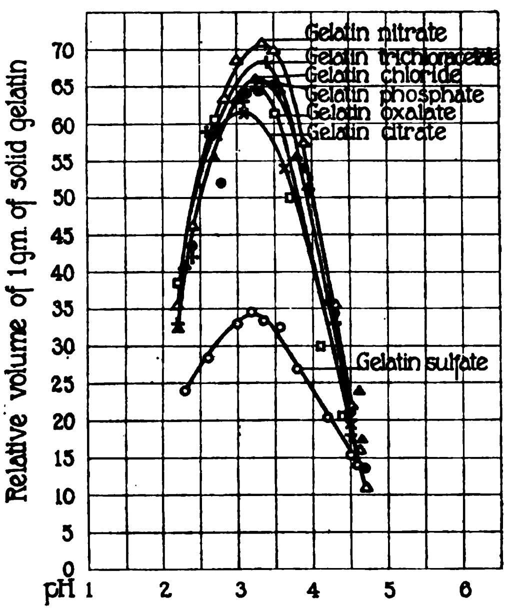


FIG. 2. Influence of different acids upon the swelling of gelatin when plotted over pH as abscissæ. The curves show that nitric, trichloracetic, hydrochloric, phosphoric, oxalic, and citric acids cause approximately the same degree of swelling, while sulfuric acid causes only about one half the amount of swelling. In the case of gelatin sulfate the anion is divalent; in the case of the other acids used it is monovalent. According to the Hofmeister series the curves for phosphate, oxalate and citrate should coincide with that of sulfate instead of coinciding with that of chloride.

When we compare monobasic acids of different strength, *e. g.*, acetic, mono-, di-, and trichloracetic acids, we find that the weaker the acid the more acid must be contained in a 1 per cent. solution of originally isoelectric gelatin to bring it to the same pH. If we compare the effect of these four acids on the osmotic presure of gelatin we find that it is (within the limits of accuracy of these experiments) identical for the same pH. The curves for the influence of these four acids on the osmotic pressure of gelatin solution are practically identical when plotted over the pH as abscissæ; and, moreover, the curves

are identical with the curves for HCl or H_3PO_4 in Fig. 1. The explanation of this fact is that at the same pH the same mass of originally isoelectric gelatin is in combination with the same quantity of these four acids and since the anions of these four acids are all monovalent the curves must be identical.

As far as the alkalies are concerned, we notice that the curve representing the effect of the weak base NH_4OH on the physical properties of proteins is the same as that for the strong bases LiOH, NaOH, KOH when plotted over pH as abscissæ, while the curves representing the effect of $Ca(OH)_2$ or $Ba(OH)_2$ on the same properties are considerably lower.

It is obvious that the valency of the ion in combination with the protein has a noticeable influence on the properties of the protein salt formed, while the protein salts with ions of the same valency have all the same properties. The fact of the greatest importance is, however, that the influence of acids and bases on the physical properties of proteins is the expression of the combining ratios of the acids or bases with proteins so that we are able to predict the value of the physical properties from the combining ratios. This fact seems to give a final decision in favor of a purely chemical theory of these influences and against the colloidal theories as based on the Hofmeister or Pauli ion series.

The behavior of the proteins therefore contradicts the idea that the chemistry of colloids differs from the chemistry of crystalloids.

JACQUES LOEB

THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH, NEW YORK, N. Y.

THE AFRICAN RIFT VALLEYS

A RECENT article[1] with the above title by Professor J. W. Gregory, of Glasgow, is of interest from the general summary that it presents of a remarkable group of natural features, as well as from the ingenious flight of geological imagination by which it explains them. The term, rift valley, introduced by Gregory in connection with his African studies of 25 years ago, designates a longitudinal depression "caused by the material sinking in mass, so that what is now its floor formerly stood level with the highlands on each side." Such valleys therefore contrast strongly with "ordinary valleys, which are caused by the removal piecemeal by rivers or wind of the material that once filled them." The omission of glaciers from the last clause is doubtless prompted by Gregory's disbelief in their capacity to erode.

His article opens with a general and for the most part an empirical account of the "Great Rift Valley" of Africa, and of the volcanoes that occur along it, with little attention to the structure of the region traversed, and with still less attention either to the erosion that the region had suffered before the assumed rifting or to the erosion that the enclosing scarps have suffered since the rifting. Apart from briefly cited opinions of various authors, form alone in most cases is appealed to in evidence of down-faulting. As a result the reader may not feel convinced that all the depressions described as rift valleys really belong in that class. Some of the limiting scarps may be purely cliffs of erosion. Indeed, the inclusion of the Red Sea, with the narrow Gulfs of Suez and of Akaba at its northwest end and the broad Gulf of Aden to the southeast of it, as rift valleys, and the drawing of several "diagonal tectonic lines" along certain parts of the east African coast that are supposed to have been "cut off by ... faulting" suggest so open a hospitality to the occurrence of rifts and rift valleys as to make the reader wonder whether they are not overworked. The first part of the article is therefore chiefly valuable as a topographic summary of a remarkable region. A critical discussion of the evidence for rifting, based on a review of the many articles cited in the bibliography, would make an excellent subject for an advanced student in physiography.

[1] "The African Rift Valleys," by J. W. Gregory, *Geogr. Jour.*, LVI., 1920, 13–47, with 6 maps, 7 profiles and 8 half-tone plates, and a bibliography of 65 titles.

The article, although published in a journal from which geological discussions are usually excluded, devotes its second part to a strictly geological discussion of the "age and history" of the African rift valley, with the result of assigning it a relatively modern date. The article closes with an inquiry into the orgin of the rift valley and its relation to contemporary earth movements; and here speculation is given free rein. The following extracts are from the second and closing parts: running comments are added. The length of the valley is "about one sixth of the circumference of the earth. It must have had some world-wide cause." It is "dependent in the main on the volcanic history of the country; the two are connected, as the subsidence of the earth blocks doubtless forced up the lavas along the fractures;" and from this it would appear that volcanic eruptions are to be regarded as caused by the sinking of the rift blocks, although the opposite view, that the eruptions caused the sinking, deserves consideration.

> The first stage . . . was the uplift of a long, low arch [by lateral pressure] with the axis trending north and south. . . . The second stage was the cracking of the sides of the arch as the lateral pressure was reduced, and the top sank as the keystone of an arch sinks if the end supports give way.

But it may be questioned whether there is any true homology between the crest of a very broad and low earth-crust anticline with plenty of subcrustal material crushed up beneath it, and the keystone of an arch of masonry which spans an open space; and moreover the lateral pressure here assumed contradicts the state of tension, mentioned below. "The sinking of the keystones . . . into the plastic material below forced some of it up the adjacent cracks, through which it was discharged in volcanic eruptions." The possibility that the primary impulse was not lateral pressure in the superficial crust, but an upward pressure of deep-seated and crowded lavas is not considered.

The speculative character of the views here exposed reaches its climax on the closing page:

> The essentially different character of the contemporary earth-movements of Africa and of the Pacific borders is explained by their antipodal position. Africa was antipodal to the Pacific, and it is in accordance with the well-known antipodal relation of ocean to continent that while the Pacific was sinking and the crust beneath it undergoing compression, its antipodal land should be rising and subject to tension. . . . The subsidence of the Arabian sea and the outflow of the vast quantities of lava to the east and west [in India and Abyssinia] left the east African arch insufficiently supported, and the top of it sank between parallel fractures. . . . Africa was in tension, and torn by north and south fractures, along which the sinking of a strip of the crust formed the longest meridional land valley on the earth. . . . There are two great regional disturbances in the Eastern Hemisphere with which they [the rift-valley faults] may be correlated; the foundering of the Indian Ocean . . . and the movements which raised the Alpine-Himalayan Mountains. . . . The Great Rift Valley . . . owes its unique character to its position antipodal to the Pacific, and its course to the wrench in the crust of the Eastern Hemisphere between the segment pressing northward against Europe and that pressing southward in Asia toward the deepening basin of the Indian Ocean.

These are truly far-reaching generalizations, but whether they will endure is uncertain. If they are correct their prophetic power is great, for the evidence to demonstrate them is not yet fully collected.

The doubts that are aroused by a reading of Gregory's article are re-enforced by the protest published a month later by Ball, of the Geological Survey of Egypt.[2] He points out that, as large sections of the supposed rift valleys are submerged in the Red Sea and the Gulf of Aden, and as not a hundredth part of the rest has been examined by competent geologists, much uncertainty must still remain as to their structural interpretation and physical origin. He adds that, as a result of Gregory's early work on the subject, some of

[2] "The African Rift Valleys," by John Ball *Geogr. Jour.*, LVI., 1920, 234–238.

the members of the Egyptian Geological Survey "became obsessed by the notion that the Nile Valley and the Gulf of Suez were parts of the rift system," and that a later interpretation of both these features as valleys of erosion—one of them moderately submerged —was much retarded by that premature conclusion. He rejects Gregory's correlation of the Pacific basin and the African plateau, doubts the production of rift valleys by tension, suggests that their structure may be due to compression, and notes that their form may have been much influenced by erosion, especially in those African depressions which have a scarp only on one side. He therefore wisely urges that the whole problem should be regarded as needing much further investigation before a safe conclusion can be announced.

Ball is, however, over-conservative in asserting that "the only sure proof of the existence of a trough fault is to be obtained by tracing across the floor of the trough the same strata as occur at higher levels in the bounding scarps." This overlooks the competent physiographic evidence of faulting that is provided when a nearly rectilinear scarp truncates a series of deformed strata or a body of massive rocks, as pointed out by Gilbert in his studies of the Great Basin ranges. For example, the trough of the Rhine from Basal to Bingen rarely shows rock outcrops on its floor; evidence of its depression between subparallel faults is derived chiefly from the topography of its enclosing scarps. Similarly, the Limagne, a broad rift-depression in central France, drained northward by the Allier between the highlands of Auvergne on the west and those of the Monts du Forez on the east, is floored with lacustrine or fluviatile sediments of modern date, while the enclosing highlands consist of ancient crystalline rocks. The existence of marginal faults here has long been accepted by French geologists, although the kind of evidence dmanded for faults by Ball is not forthcoming. Crystalline rocks are not seen on the floor of the depression, and even if they were, they could not be proved to be down-faulted. The evidence of down-faulting is found in the nature of the enclosing scarps. It may be noted in passing that the Limagne is not strictly a rift valley, but a resequent rift valley, in that since its first production by down-faulting, when it was truly a rift valley, it has been filled with inwashed sediments to the level of the enclosing highlands at a time when the whole region stood lower than now, and later on, after a broad elevation without faulting, the inwashed sediments have been washed out as deep as river-grade permits, thus again leaving the enclosing scarps in relief. The evidence of this succession of events is clearly furnished by the presence of isolated volcanic necks in the midst of the depression, and of surviving spurs of the weak sediments capped with lava flows, that project into the depression about at the level of the adjacent highlands. A resequent rift-valley of this kind must evidently differ from an initial rift-valley in having the height of its enclosing scarps determined by the depth of recent erosion, not by the drop of the original faulting.

To return to Africa: If so great a series of rift valleys really exists there as is represented on Gregory's map, some of them should show scarps that truncate the structures of the enclosing highlands, and the evidence that such scarps provide for down-faulting should not be overlooked. The possibility that some of the African rift valleys have been filled and excavated again in resequent fashion like the Limagne should also be inquired into.

W. M. DAVIS

CAMBRIDGE, MASS.,
October 31, 1920

SCIENTIFIC EVENTS

THE SIXTEENTH ANNUAL NEW ENGLAND INTERCOLLEGIATE GEOLOGICAL EXCURSION

THE sixteenth excursion of the New England geologists was taken in the vicinity of Middletown, Connecticut, October 8 and 9, under the direction of Professors William North Rice and Wilbur G. Foye. About twenty-five persons were in attendance, among whom were representatives from Harvard, Massachusetts Agricultural College, Mount

Holyoke, Smith, Trinity, University of Vermont, Wesleyan, Williams and Yale.

On Friday afternoon, October 8, the pegmatite dikes at Collins Hill, Portland, were visited. Twenty-two mineral species have been found at this locality and the party was fortunate in collecting, among other species, flat, purple, transparent apatite crystals which showed strongly developed facets of the first and second order prisms, the first and second order pyramids, and the basal pinacoid. The relations of the pegmatites to the Bolton schist, the intrusive contacts of the Maromas and Glastonbury gneisses with the schist, the interglacial course of the Connecticut river were brought to the attention of the party.

Friday evening an excellent buffet lunch was served at Fish Hall by invitation of Wesleyan University. After the lunch the party listened to an address by Professor W. M. Davis, whose classic work on the complicated structure of the Connecticut Triassic has long been a model for structural geologists. During the lecture he gave a most interesting account of the methods he employed in working out the fault structures in the vicinity of the excursion of the following day. He also discussed the mechanics of the faulting and erosion which produced the striking topography of the Connecticut valley.

At the conclusion of this lecture, Professor Rice, also a pioneer student of the Connecticut Triassic, described in detail the faulted structures between the Lamentation Mountain and the Hanging Hills blocks which were to be visited on the morrow. Professor Foye exhibited a collection of minerals from the pegmatite dikes in the vicinity of Middletown, and gave a brief account of the localities from which they were obtained.

Saturday morning the party was conducted by autotruck and on foot to some of the step faults and drag dips along the line of the great fault described by Professor Rice the evening before.

Lunch was eaten at Spruce brook by a picturesque waterfall. After lunch the resignation of the secretary who had been in office for eighteen years was accepted, and Professor Foye was elected for an indefinite term.

At Spruce Brook the contact of the main trap sheet with the overlying conglomerate was studied. Pebbles of the underlying trap were found in the basal layers of the conglomerate and the contemporaneous character of the main sheet was established.

At two localities, lying west of Lamentation Mountain, the problematic "pillow lavas" of the anterior sheet were examined, and their origin discussed by members of the party. The Meriden "ash bed," also within the anterior sheet, was visited and created considerable discussion, but the general opinion favored a volcanic source for the deposit.

At the Lane quarry north of Meriden was seen a pahoehoe surface of lava overlain by a denser flow showing that, in this locality at least, the main trap sheet did not consist of but a single flow.

None of the many enjoyable and profitable excursions taken by the New England geologists has been more successful than this one.

HERDMAN F. CLELAND,
Retiring Secretary

"PHYSIOLOGICAL REVIEWS"

A NEW journal under this name will be published quarterly by the American Physiological Society under the editorial direction of W. H. Howell, Baltimore; Reid Hunt, Boston; F. S. Lee, New York; J. J. R. Macleod, Toronto; Lafayette B. Mendel, New Haven; H. Gideon Wells, Chicago; D. R. Hooker, Managing Editor, Baltimore.

The main purpose of the *Physiological Reviews* is to furnish a means whereby those interested in the physiological sciences may keep in touch with contemporary research. The literature, as every worker knows, is so extensive and scattered that even the specialist may fail to maintain contact with the advance along different lines of his subject. The obvious method of meeting such a situation is to provide articles from time to time in which the more recent literature is compared and summarized. The abstract journals render valuable assistance by condensing and classifying

the literature of individual papers, but their function does not extend to a comparative analysis of results and methods. Publications such as the *Ergebnisse der Physiologie*, the Harvey Lectures, etc., that attempt this latter task, have been so helpful as to encourage the belief that a further enlargement of such agencies will be welcomed by all workers. It is proposed, therefore, to establish a journal in which there will be published a series of short but comprehensive articles dealing with the recent literature in physiology, using this term in a broad sense to include bio-chemistry, biophysics, experimental pharmacology and experimental pathology.

The editorial board will select subjects and assign them to authors. The articles will contain complete bibliographical lists and will be as short as the material under treatment will allow. Thus it is estimated that the first volume will contain twenty articles averaging twenty-five pages each. The character and scope of these articles may be judged by the contents of Volume I, which are planned to be as follows:

JANUARY

The regulation of the pulmonary circulation: CARL J. WIGGERS.

The origin and propagation of the cardiac impulse: J. A. E. EYSTER and W. J. MEEK.

The anaphylactic reaction: H. GIDEON WELLS.

Photo-electric current in the eye: CHARLES SHEARD.

The carbon dioxide carrier of the blood: DONALD D. VAN SLYKE.

APRIL

Blood volume and its regulation: JOSEPH ERLANGER.

The sugar of the blood: J. J. R. MACLEOD.

The circulation in the capillaries and veins: DONALD R. HOOKER.

The heat regulating mechanism of the body: HENRY G. BARBOUR.

Contributions of war surgery to the physiology of the (central) nervous system: GILBERT HORRAX.

JULY

Structure and significance of the phosphatids: P. A. LEVENE.

Physiological oxidations: H. D. DAKIN.

Tests for muscular efficiency: E. G. MARTIN.

Intestinal absorption: SAMUEL GOLDSCHMIDT.

Gastric secretion in health and disease: A. J. CARLSTON.

OCTOBER

The afferent paths for the visceral reflexes: S. WALTER RANSON.

The physiological effects of undernutrition: GRAHAM LUSK.

Adsorption in physiological processes: ALBERT P. MATHEWS.

The vitamines: H. C. SHERMAN.

Physiological effects of altitude: EDWARD C. SCHNEIDER.

UNIVERSITY OF PENNSYLVANIA LECTURES

TWENTY-FIVE lectures by members of the faculty of the University of Pennsylvania will constitute the free lecture program for the present academic year. All lectures will be given in Houston Hall. The lectures on scientific subjects are as follows:

Nov. 13—"Franklin's life in title pages," Asa Don Dickinson.

Nov. 27—"New light on plant feeding," Rodney H. True, Ph.D.

Dec. 4—"Some applications of biochemistry," George H. Meeker, M.D., LL.D.

Jan. 22—"Engineering and science," Milo S. Ketchum, B.S.

Feb. 12—"Bessemer steel first invented in America," Herman C. Berry, B.S.

Feb. 19—"Death from the standpoint of the physiologist," Edward Lodholz, M.D.

March 5—"Some important phases of public health," Henry R. M. Landis, M.D.

March 12—"Floral calendars and floral clocks," John M. Macfarlane, D.Sc.

March 19—"The criminal prosecution of animals and inanimate objects," Walter W. Hyde, Ph.D.

March 26—"Electrical transmission of power," Harold Pender, Ph.D.

April 2—"The relation of bacteria to health and disease," David H. Berger, Dr.P.H.

April 9—"Methods of determining celestial distances," Samuel G. Barton, Ph.D.

April 16—"The elimination of vibration and noise," Thomas D. Cope, Ph.D.

April 30—"The advances of medicine in the nineteenth century," Alfred Stengel, M.D., Sc.D.

May 7—"Louis Pasteur: the world's greatest benefactor," Ernest Laplace, M.D., LL.D.

THE SECTION OF ZOOLOGY OF THE AMERICAN ASSOCIATION

THE Convocation Week meetings of Section F (Zoology) of the American Association for the Advancement of Science will be held in conjunction with those of the American Society of Zoologists at Chicago University, Chicago, Illinois, December 28, 29 and 30. As the officers of the American Society for Zoologists are responsible for the program under the rules of the American Association, all titles and abstracts of papers should be sent to Professor W. C. Allee, Lake Forest College, Lake Forest, Illinois.

The address of the retiring vice-president of Section F, Professor William Morton Wheeler, will be given at the Zoologists Smoker, Tuesday evening, December 28.

H. V. NEAL,
Secretary of Section F
TUFTS COLLEGE, MASS.

SCIENTIFIC NOTES AND NEWS

DR. SAMUEL JAMES MELTZER member of the Rockefeller Institute for Medical Research and head of the department of physiology and pharmacology, died on November 7 at the age of sixty-nine years.

THE address of Dr. Simon Flexner, as retiring president of the American Association for the Advancement of Science, will be given at the Chicago meeting on the evening of Monday, December 27, instead of on Tuesday evening as originally planned.

SIR ALMROTH WRIGHT, has received the first award of a gold medal established through the gift of an anonymous fellow of the Royal Society of Medicine and open to medical practitioners throughout the world.

AT the conclusion of the Harveian Oration, delivered by Sir Frederick Andrewes on October 18, before the Royal College of Physicians of London, the President, Sir Norman Moore, presented the triennial Bisset Hawkins memorial medal for distinction in public health to Dr. W. H. Hamer, medical officer of health to the London County Council.

DR. WALDEMAR T. SCHALLER has severed his connection with the Great Southern Sulphur Co., Inc., of New Orleans, La., and has returned to the U. S. Geological Survey, Washington, D. C.

MR. H. H. BROWN, formerly connected with the Bureau of Chemistry, Department of Agriculture, where he was in charge of the chemical investigations on the cause and prevention of dust explosions, is at present employed by the Pejepscot Paper Co., Brunswick, Maine, to establish a chemical research laboratory and to investigate chemical problems connected with the manufacture of paper and the utilization of waste products.

AT a meeting of the Institute of Medicine of Chicago, October 29, Professor Graham Lusk, New York, delivered the first Pasteur Lecture on "Some influences of French science on medicine."

DR. VICTOR G. HEISER, director for the East of the International Health Board, recently delivered a lecture at the School of Hygiene and Public Health of the Johns Hopkins Hospital on the work done by the United States government in the betterment of health conditions in its dependencies.

MR. ELMER A. SPERRY, president of the Sperry Gyroscope Company, of New York, is to give a demonstration lecture at the Harvard Union, November 15, at 8 P.M., on "Applications of the gyroscope to navigation." The lecture is held under the auspices of the department of astronomy at Harvard University, and will be open to the public.

THE eleventh course of lectures under the Herter Foundation was delivered by Dr. Jules Bordet, director of the Pasteur Institute, Brussels, in the Johns Hopkins Hospital, on October 26, 27 and 28.

THE Emil Fischer memorial lecture was delivered by Dr. M. O. Forster at the meeting of the Chemical Society, London, October 28.

MEMORIAL exercises for the late Dr. Samuel Sheldon, professor of physics and electrical engineering at the Polytechnic Institute of Brooklyn, will be held in the auditorium of

the Engineering Societies Building in New York City on the evening of November 17. Addresses will be made by Dr. Arthur E. Kennelly, professor of electrical engineering at Harvard University; Dr. William H. Nichols, chairman of the corporation of the Polytechnic Institute; Mr. T. Commerford Martin, secretary of the National Electric Light Association; Mr. Bancroft Gherardi, vice-president of the American Telephone and Telegraph Co., and William N. Dickinson, president of the New York Electrical Society. Mr. Arthur W. Berresford, president of the American Institute of Electrical Engineers, will preside.

M. Louis du Hauron, a pioneer in the photography of color, died on August 31, at the age of eighty-three years.

The death has occurred on the way to New York of Dr. Manuel C. Barrios, professor of physiology and later of legal medicine at the University of Lima, Peru. While a member of the national cabinet he organized the public health service and founded the National Academy of Medicine.

Dr. J. P. Morat, formerly professor of physiology at the University of Lyons, has died at the age of seventy-five years.

The Berlin correspondent of the *Journal* of the American Medical Association writes that the first meeting in seven years of the Association of German Scientific Men and Physicians, held at Bad Nauheim, was attended by 2,600 members. Among the principal subjects of interest of the meeting were the newer researches in physical science, including the structure of molecules and atoms, and the Einstein theory of relativity. The papers of Dr. Max Rubner, Berlin, and Dr. M. von Gruber, Munich, on the problem of nutrition were probably the outstanding medical contributions.

The Swedish government has approved the plan to found an institute for research on moral assistance for the furtherance of medical faculty to plan the institution. A committee from the faculty has been appointed for the purpose, comprising Drs. Lennmalm, Johansson, Müller and Gadelius, of the chairs of neurology, physiology, anatomy and psychiatry, respectively.

The will of the late Dr. Lloyd Roberts, of Manchester, contains the following bequests: To the Rylands Library, Manchester, such of his bound books as the trustees may select; to the Corporation of Manchester, for the Art Gallery, such of the mezzotints, water-colors, and paintings as they may desire; to the Royal Society of Medicine £5,000; to St. Mary's Hospital, Manchester, £5,000; to Manchester Royal Infirmary, £3,000; to the Royal College of Physicians, London, £3,000; to the Medical Society of London, £2,000; to St. David's College, South Wales, £2,000. The residue of his estate is left to University College, Bangor, with provision that £5,000 be set aside to found a Lloyd Roberts professorship in any subject the authorities think fit.

Professor A. F. Rogers, of Stanford University, is engaged in a mineralogical study of fossil bone and will welcome any specimens that may be sent to him. Small specimens, 2 or 3 inches in size, will suffice. They may be sent by express, collect to the Mineralogy Laboratory (care of A. J. Rogers), Stanford University, California.

There has recently been formed at Brussels a Fédération belge des sociétés des sciences mathématiques, physiques, naturelles médicales et appliquées. According to the *Journal* of the American Medical Association thirty-three societies have already joined the federation, and many others have promised to become affiliated in the near future. The group includes various scientific societies which give evidence of their activity by the publication of original work, and the movement is designed to unite and coordinate all efforts for the general advancement of the pure and applied sciences, although the component societies retain their own autonomy. The federation will endeavor to encourage initiative and to procure the requisite material and moral assistance for the furtherance of scientific work, and it will collaborate in perfecting scientific publications. It may, especially, summon congresses, organize confer-

ences and expositions, and found or support useful scientific institutions. Among the principal aims of the federation may be mentioned: (1) an increase of the resources of affiliated societies sufficient to continue their publications, and (2) the collection of works published by the federated societies and exchange of publications with analogous federations in allied and neutral countries. A general council of fifteen members administers the affairs of the federation. The officers for 1920 are Professor de la Vallée-Poussin (Louvain), president; Paul Pelseneer (secretary of the Académie royale de Belgique), vice president; J. Wauters (secretary general of the Société chimique de Belgique) treasurer, and Messrs, Zunc and Lucien, secretaries.

UNIVERSITY AND EDUCATIONAL NEWS

THE Hudson's Bay Company, as one means of celebrating the 250th anniversary of its foundation and its long connection with Western Canada and with Winnipeg, has given the University of Manitoba a fellowship of the annual value of $1,500 for the years 1920–29 inclusive, open to graduates of any Canadian university. Each fellow will devote his entire time to original research in some branch of pure or applied science.

A LABORATORY for research on dyestuffs and explosives has been established at George Washington University, under the general supervision of Professor H. C. McNeil, and in charge of Mr. G. W. Phillips, formerly of the Chemical Warfare Service. Dr. Charles E. Munroe will be consulting chemist of the laboratory.

DR. S. A. MAHOOD, of the Forest Products Laboratory, Madison, will have charge of chemistry at Tulane University.

DR. JAMES W. PAPEZ, professor of anatomy and neurology at Emory University School of Medicine, Atlanta, Ga., has resigned to accept the assistant professorship of neurology at Cornell University Medical College, Ithaca, New York.

DR. KENNETH D. BLACKFAN, associate professor of pediatrics at the Johns Hopkins Medical School, has been appointed professor of pediatrics at the Medical College of the University of Cincinnati.

OLAF P. JENKINS has returned to Pullman, Washington, as assistant professor of economic geology in the State College of Washington, having spent the last year with the Sinclair Exploration Company as chief geologist in Alabama.

DR. C. NUSBAUM, formerly of the Magnetic Section of the Bureau of Standards, has been appointed research associate in the division of industrial research and cooperation of the Massachusetts Institute of Technology.

DR. HENRY W. STAGER, for many years head of the department of mathematics in Fresno Junior College, Fresno, California, and more recently with the United States Railroad Administration, has been appointed instructor of mathematics in the University of Washington, Seattle, Washington.

MR. W. VERNON GODSHALL, formerly assistant professor of chemistry at Miami University, has accepted a similar position in physiological chemistry in the department of physiology of the University of Wisconsin. He is also chemist on the Interdepartmental Board for the estimation of the elimination of arsenic from patients treated with arsenical drugs.

AT the Montana School of Mines Assistant Professor Gerald S. Lambert, of Leland Stanford University, has been appointed associate professor of geology, and Dr. A. E. Koenig, assistant professor of chemistry at the University of Wisconsin, associate professor of chemistry.

DR. RODNEY B. HARVEY has resigned as plant physiologist, Bureau of Plant Industry, Washington, D. C., to accept the position of assistant professor in plant physiology at the University of Minnesota, and assistant plant physiologist in the Minnesota Experiment Station.

MR. F. B. SMITH, who recently retired from the position of secretary of agriculture to the

Union of South Africa, has been appointed a reader in estate management at Cambridge

DISCUSSION AND CORRESPONDENCE

THE PRESERVATION OF WILD LIFE

The Ecological Society of America's committee on the preservation of natural conditions, while unable to deal with problems concerning wild life not in reserves, continually encounters the fact that individual species are menaced with extinction by agricultural encroachments. Two of these menaces are:

1. Clean-culture (roadside mowing and burning) as distinguished from roadside and streamside shrubbery and bird and original life preservation.

Birds are decreasing for lack of nesting sites, on account of destruction of breeding conditions. Entomologists and some agriculturists maintain that this condition is necessary to agriculture. Bird men insist that birds are also essential. It is known that a few states encourage roadside shrubbery while several require roadside mowing. The practise in the various parts of the United States and Canada should be ascertained. The effect of different procedures should be determined. The areas in which specially destructive and drastic measures such as burning for insect pests are necessary should be clearly defined and limited and the public informed as to the dangers of such burning.

2. Upland marshes are important as sponges storing water and letting it out slowly during dry seasons, thus controlling floods. Such marshes are gradually being drained and the flood menace is increasing every year.

The only way to save these natural resources and at the same time, the swamp faunas, especially the birds, is to utilize the swamps for aquiculture. To this end several water-culture experiment stations should be established. For the present there should be one, perhaps at Cornell University, to deal with the upland marsh problems. There should be another in connection with Okefinokee swamp and one in connection with the coastal swamps of New Jersey. In addition to frogs, fish, and birds, a number of plants are good for food, etc.; *e. g.*, cattail flour and cattail paper have recently been tried with success. Swamp potatoes, the corns of arrowhead, and seeds, roots, and stalks of our native lotus served as food for the American aborigines and pioneers. Hedrick (SCIENCE, 40:611), Claussen (*Sci. Mo.*, 9:179), and Needham and Lloyd ("Life of Inland Waters") have discussed these questions and suggested or advocated the improvement and culture of aquatic plants.

It is the belief of the committee that all organizations in any way interested should combine efforts for the investigation of these questions.

For a list of the committee members, see SCIENCE, March 26, 1920; since that date the following have been added: Z. P. Metcalf, University of North Carolina; C. A. Shull, University of Kentucky; R. M. Harper, College Point, N. Y.; and Jens Jensen, Ravinia, Illinois.

V. E. SHELFORD,
Chairman

UNIVERSITY OF ILLINOIS

PREDILECTION AND SAMPLING OF HUMAN HEIGHTS

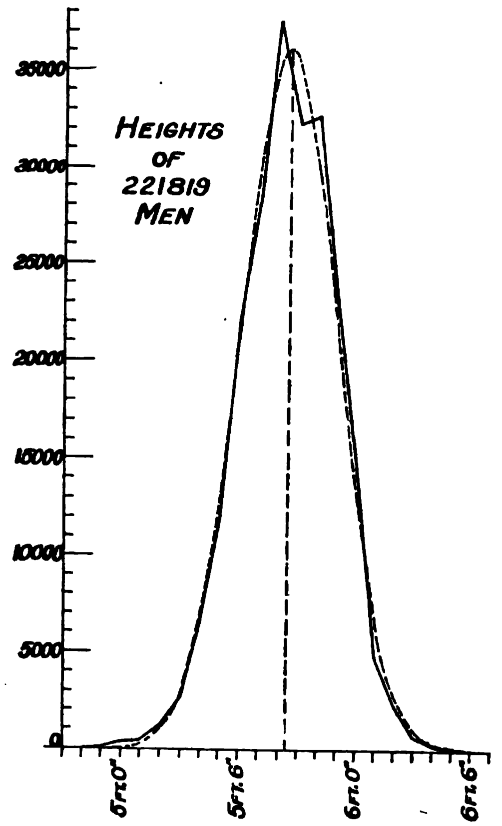
TO THE EDITOR OF SCIENCE: Extensive reliable data showing the distribution of human heights in "unselected" populations are surprisingly hard to obtain. The Association of Life Insurance Medical Directors and the Actuarial Society of America have, however, undertaken a very careful statistical study of men accepted for life insurance,[1] which provides, among other things, a distribution of the heights of 221,819 men. Here, at last, we might expect to settle the question of the form of distribution that would hold for a population, but we discover in the distribution curve a remarkable inversion that it is difficult to explain as anything other than an artefact.

This distribution curve is the solid line of the figure. The average height is 5 ft. 8.49 in. Since the curve is plotted in units of an inch,

[1] "Medico-Actuarial Mortality Investigation," Vol. I., 1912, esp. 11–22.

the peak is at 5 ft. 8 in. The inversion occurs just above the peak: there are fewer men recorded at 5 ft. 9 in. than at 5 ft. 10 in. That the inversion is not due to the inclusion of men of different ages in the same curve is shown by the fact that it occurs for ten of thirteen age-groups (five-year range) taken separately.

The question arises as to the cause of this striking feature of the curve.



We are at liberty to conclude that the observed curve is the "true" distribution of American male heights, but most persons, whether they believe in the *a priori* necessity of the Gaussian form of distribution or not, will be under a strong conviction that the curve should at least be smooth and not bimodal.

The alternative explanation is that the inversion is an artefact. The sampling of the records in the offices of the insurance companies was carefully done. All risks accepted during January of the odd years and July of the even years throughout a sixteen-year period were included. It would seem probable, therefore, that the selection must have occurred when the measurements were made. Many persons who were nearest 5 ft. 9 in. must have been recorded as 5 ft. 8 in. or 5 ft. 10 in. Here we would have a case of artificial selection that depends on the factors involved in obtaining measurements, a case analogous to the predilection that occurs when estimates are made in "round numbers" or, as happened in this investigation, to the predilection to give weights as multiples of five pounds.[2] We may hazard that the error occurred not so much in reading the measuring stick as in the acceptance by the examining physician of the person's own statement of his height. There may be a tendency for a person to prefer an even 8 or 10 in. height to an odd 9. There is, however, no similar inversion obvious at 4 ft. 8–10 in., although this may be obscured by the effort of men of this height to have themselves recorded as 5 ft.; there is a suspicious bump in the curve just above 5 ft. And the cases at 6 ft. 8–10 in. are too few to show.

The further question arises whether the predilection is simply against the 9 in. or whether all even heights are favored. It is not possible to determine this accurately, since an inversion can not so readily appear in the steeper parts of the curve. If we take the Gaussian distribution (dotted line in the figure) as ideal we see that it is not true that even inches fall above this ideal and odd below. But then it is doubtful whether the Gaussian distribution should be ideal. You can not, at least, prove it from these data, since the probability that an ideal Gaussian distribution would turn out as this observed distribution has is only (by Pearson's chi^2-criterion) about one chance in $10^{[illegible]}$.

We appear to have, then, a special predilec-

[2] For a complete discussion of the influence of these communal mental habits upon scientific measurements and other quantitative judgments, see J. E. Coover, "Experiments in Psychical Research," 1917, 229–290.

tion in favor of a height of 5 ft. 8 in. or 5 ft. 10 in., or both, which is a function simply of human preference for these heights. The writer would appreciate any information from the readers of SCIENCE which indicates other ways in which this inversion might have been brought about, or which goes to show that persons would tend to regard these two heights as especially desirable.

The instance shows how difficult it is to obtain an "unselected sample" by merely securing large numbers of cases without scientific control of the original observations.

EDWIN G. BORING

CLARK UNIVERSITY

THE PLIGHT OF SCIENTIFIC PERIODICALS[1]

THE world of to-day is in new and trying situations. It is trying its best to meet the conditions imposed upon it by the experiences of the last six years, without relinquishing all of its former ideals.

Its situation is somewhat like that of a family whose house burned last night, but whose clothing and furniture were saved through the energy of the neighbors. Morning has come and reveals the state of confusion. Mother's slippers are in the coffee pot and the lamp shade is full of potatoes. Everything is there, but it will require a long time to bring order out of confusion, at the same time the family must live and maintain domestic peace.

In this country the average man is of the opinion that science had much to do in deciding the military and economic issues from 1914 to 1918. It is not, however, altogether unlike human nature that it should forget its benefactor, though still grateful for the benefactions. Nevertheless, science in this country is to-day in a precarious condition because of the embarrassed financial condition of its professional magazines. It has always been difficult to get scientific work published in this country. The publishers were always politely regretting their inability to publish scientific material, because they had found by experience that it did not pay. The public seemed to have so many other ways in which to spend its money that it didn't want to buy dry books or periodicals.

Science is advanced by research work. That which is discovered is published in technical periodicals or books in the hope that it may advance knowledge and contribute to human welfare. Research work is mainly done by men and women connected with educational or public service institutions. The discoveries which they make are for the benefit of the public rather than the discoverer. Few of their discoveries can be capitalized for personal advantage, and few of the workers have any inclination in that direction. They furnish their original researches to scientific periodicals without receiving reimbursement for them. The main thing the investigator seeks is the opportunity to present his results in an adequate and dignified way to those who may enjoy or use them, and with reasonable promptness.

Consider the situation of the worker in science at the present time. He sends his manuscript to the editor of the *Journal of* ————. In due time he receives some such letter as this:

> We should be glad to publish your manuscript in the *Journal of* ————, but our funds are so restricted that we are obliged to cut down articles as much as possible. In view of the increased cost of printing we want to ask if you would be willing to omit the introduction and first three tables and to combine the other tables into one. We are trying to restrict all articles to ten pages or less of printed matter. The illustrations can not be published unless you will bear the entire cost of plates and paper yourself.
>
> Regretting that such restrictions are necessary, we beg to remain, etc.

The author is obliged to accede to the editor's requests if his paper is to be published and writes accordingly. In about eight months he receives the proof sheets and about a year from the time the manuscript was written the journal containing it is issued. The magazine is thin and pale in appearance. In a few weeks the author gets a package of reprints for which he has to pay at the rate

of 84 cents a page. In addition he is a subscriber to the Journal at $6.50 a year.

In contrast we see that the "popular" magazines flourish as never before and publish beautiful color illustrations galore. We are told that scientific periodicals can not have these things because *they* don't pay." We wonder, Does not science pay to-day as well as in 1917? Will it "pay" to let the scientific world send to Leipzig for its periodicals, rather than to Baltimore?

If scientific publications are to survive and if this country is to support scientific work as it supports other things, there must be some form of endowment for that purpose. Corporations and individuals whose business is even remotely connected with the results of scientific work will find it a good investment in years to come.

The scientists are willing, and do, bear more than their share of the expense of their publications, but outside help is necessary. These periodicals can not expect to pay dividends to the publisher because they are unattractive to advertisers as a class. The technical and scientific periodicals need endowments sufficient to allow them to present adequately the results of research and to enable them to circulate at a subscription price low enough to enable all workers and libraries to buy them.

HOWARD S. REED
CITRUS EXPERIMENT STATION,
RIVERSIDE, CALIFORNIA

ROAD REFLECTIONS

TO THE EDITOR OF SCIENCE: Referring again to the subject of road reflections, Mr. Freemen F. Burr in SCIENCE for September 24 notes having observed reflections occurring at considerable heights above the surface of the road. I have made thousands of careful observations of this phenomenon and have found that the reflecting surface always coincides with the road surface as closely as the eye can determine.

Since the true surface disappears when a reflection takes place there is often an appearance of shifting which careful observation shows to be illusory. Thus a reflecting surface on the top of a hill sometimes seems at a casual glance to be several inches from the road and seems to hide objects beyond. In every such case the hill itself is what cuts off the vision.

I have observed the reflections many times under circumstances that preclude entirely the ascribing of them to warm layers of air. I have seen them on cloudy days, on shaded stretches of road and in one place where a white sign-board furnishes a convenient background a very striking reflection may be seen long after sunset.

To be sure they are much more in evidence on bright days than on dull days, but since they appear even more brilliantly on a very cold bright winter day with snow on the ground than on a warm summer day the conclusion to be drawn is that the contrast of bright colors throws the reflections into more prominent relief on sunny days.

The same phenomenon may be observed by holding any smooth normally non-reflecting surface, such as that of tarnished metal or of a smooth whetstone, at a small angle to the line of vision. Objects beyond appear brilliantly reflected as if in a mirror.

It may be that in some instances a thin air layer immediately adjacent the surface aids by bending some incident rays so that they strike within the critical reflection angle. But the air layer certainly is never primarily responsible for reflections of this kind.

H. H. PLATT
SCARSDALE, N. Y.

THE INFLUENCE OF FRESH FOOD IN LACTATION

THE suggestion of Hart, Steenbock and Hoppert, in the October 1 number of this journal, that a vitamine in fresh grass favorably influences calcium metabolism is a step in a direction in which, I am convinced, important progress is to be made.

Through extensive investigations on the mineral metabolism of farm animals I had reached a hypothesis identical with the provisional conclusion of Hart and associates,

and had planned work to reveal the facts. Fortunately the department of dairy husbandry of this institution, under the leadership of Professor C. C. Hayden, has had in progress for many years an investigation with dairy cows contributing evidence directly on this subject; and during the past summer the writer has had under observation this same group of cows on which he was conducting mineral feeding experiments.

Mr. Hayden permits me to make the following observations on these cows. Since 1911 a group of Holstein-Friesian cows has been maintained on dry feeds and silage alone. No green feed has been allowed. Several of the animals now in this group were born in the same and have grown to full maturity without having a bite of green feed. Extensive evidence is at hand, therefore, as to the importance of the suggestion of Hart and associates, as bearing on lactation in cattle.

This group of cows has grown to normal weights, and has produced and reared calves without marked or certain irregularity or abnormality. The milk production has been fair only, it being obvious that with normal treatment these cows would have given more milk. They do not have normally keen appetites and some are easily forced off feed. They will not eat enough feed to support maximum milk production. They fall away during lactation a little more than is customary, but pick up again after going dry. These cows have been in noticeably less thrifty condition, as indicated by flesh and coats, than the balance of the herd, which goes to pasture, and it has been apparent that they crave something which they do not find in the ration.

During the past summer the writer has conducted palatability tests on these cows, with various mineral supplements. They have manifested a keen desire for mineral feeds, having eaten, in several short periods, from approximately three fourths of a pound to more than one and a fourth pounds of mineral supplement per head per day. These supplements have consisted of various calcium phosphate and carbonate preparations, fed alone or mixed with common salt. It has been shown that the desire of the cows for these feeds has not been wholly or predominantly due to the liking for salt. The avidity with which these cows eat steamed bone, considered in connection with our finding that negative calcium balances normally prevail during lactation in cows on dry feed, and the conclusion of Hart and associates that fresh grass favorably affects calcium retention, suggests that these dry-fed cows are in a state of mineral depletion, especially while giving milk.

It appears, therefore, that the suggestion of Hart and associates is a matter of practical importance as relating to milk production, but that rations of dry feeds and silage, though probably deficient in some constituent, are not entirely lacking in any essential.

The most important work indicating the dependence of calcium metabolism, especially of the teeth, upon vitamines, which has come to the writer's attention is an extensive and unusually successful investigation with guinea pigs (as yet unpublished) by Dr. Percy R. Howe, of Harvard University.

E. B. Forbes

Department of Nutrition,
Ohio Agricultural Experiment Station

SWARMING OF ANOPHELES

To the Editor of Science: It may seem a little late to publish this note, but, on account of a long absence from the country, I have only just seen reference, in the *Review of Applied Entomology* for May, 1920, to Mr. C. S. Banks's article entitled "The Swarming of Anopheline Mosquitoes" published in the *Philippine Journal of Science* for September, 1919. Mr. Banks is quoted as stating in the article that, although the swarming of mosquitoes has been constantly reported, "no mention seems previously to have been made of this habit in the case of Anophelines." As a matter of fact the late Mr. Frederick Knab published in *Psyche* for February, 1907, a rather extended note on the swarming of *Anopheles maculipennis* Say. This note is reprinted in full in the Monograph of the

Mosquitoes of North and Central America and the West Indies, published by the Carnegie Institution of Washington, and in that connection observations of a somewhat similar character by several other authors are mentioned (see pages 126–129, Vol. I. of the Monograph).

L. O. HOWARD

THE WORKS OF AMEGHINO

THE Minister of Public Works of the Province of Buenos Aires, Argentine Republic, is financing the publication of a complete edition of the scientific writings and correspondence of Florentino Ameghino (1854–1911) the distinguished South American paleontologist. The editorial work has been undertaken by Alfredo J. Torcelli, and Volumes I. and II. have been issued; though printed in 1913–14 they have just been received. Volume III. will be devoted to "The Antiquity of Man in La Plata," originally issued in two volumes in 1880–81.

The publication of such a work, stupendous as it is, will prove of inestimable value to those workers who entered the field after Ameghino had published his first papers, copies of which are rarely found in an ordinary scientific library. His writings number 179 essays and books written in Spanish, French and English; some of them large volumes. Ameghino was a voluminous writer and he seldom published short papers. While the number of papers is not large compared to some European writers; Hermann Schaaffhausen for instance, wrote 314 contributions along the lines of anthropology; yet in content they compare favorably with the productions of any one scientific writer of modern times.

The first volume is entitled "Vida y Obras del Sabio," an octavo of 391 pages, printed on a poor quality of paper, and containing a complete account of the life and activities of this noted South American scholar. There is likewise appended a description of the elaborate funeral ceremonies with which his native city mourned the loss of this eminent man.

The second volume with the title: "Primeros Trabajos Cientificos," is much larger, comprising 770 pages. One regrets the poor quality of the drawings; but it must be remembered that Ameghino's drawings, of which there were thousands, were made by his own hand, untrained to do such work, and under unfavorable conditions, working in the back room of his stationery shop in La Plata. The drawings originally poor and not well produced at first, are not all we would like, but are still of great value as an aid in interpreting Ameghino's ideas.

The third volume will comprise the XXIVth memoir, and since there are 154 memoirs to follow one can, with a little simple mathematics, compute the approximate size of the series. An interesting sidelight to Ameghino's restless mental activity is given in Memoir XXIII., with the title "Taquigrafia Ameghino," which appears to be an attempt on his part to reduce the Spanish language to shorthand; the characters having a marked resemblance to those used in some American shorthand systems. It is to be hoped that his shorthand system was successful. But of its use in the commercial world of Spanish-speaking peoples, I know nothing. How many living paleontologists have devised a system of such far-reaching importance to another world than their own?

Florentino Ameghino was a wonderful man, and I am sure we wish Alfredo J. Torcelli all the success in the world in his "honorable autant que difficile travail."

ROY L. MOODIE
DEPARTMENT OF ANATOMY,
UNIVERSITY OF ILLINOIS,
CHICAGO

SPECIAL ARTICLES

THE FREE-MARTIN AND ITS RECIPROCAL: OPOSSUM, MAN, DOG

IN 1917 the writer purchased a large fat opossum, presumably a male, but actually a sex-intergrade possessing the following characters: externally, normal penis, empty scrotum, small malformed pouch, head rather like that of a female; internally, reproductive organs distinctly of the female type, infantile

in development, consisting of vaginal canals, uteri, Fallopian tubes, and small round bodies in the situation of the ovaries. These bodies were sectioned and found to contain within a thin albuginea a mass of closely packed tubules of uniform size, devoid of all indication of sex cells, male or female.

This specimen is presented in further evidence of the hormone theory of sex differentiation, in the light of which it is interpreted. The explanation here offered was suggested by Lillie's beautiful demonstration of the cause of the free-martin in cattle,[1] wherein he showed beyond all doubt that the free-martin is a female sterilized by sex hormones from the male co-twin in all cases, and only in such cases, in which the fetal circulations anastomose and mutual blood transfusion occurs. One type of pseudohermaphroditism is thus adequately and simply explained and Steinbach's[2] assumption of an embryonic gonad containing both male and female interstitial cells as the origin of the antagonistic sex hormones in fetal life becomes superfluous.

The opossum briefly described above is interpreted as a reciprocal free-martin, a term I wish to employ for a sex-intergrade which is zygotically *male* but which in its ontogeny develops *female* characters. I venture to suggest that it has arisen by "inhibition and stimulation of normal embryonic rudiments"[3] through the influence of female hormones from a female co-twin. It is believed, therefore, that the case constitutes an answer to the following significant statement by Lillie:

> On the male side there is complete absence of information as to the effects of early embryonic castration and the possible effect of the presence of female hormones in the absence of male hormones.[4]

The writer acknowledges, of course, that he is arguing from analogy; and he would himself interpose the further objection that such sex-intergrades are very rare, at least in adults of the opossum. And yet, when one opens a pregnant opossum uterus and observes that it is crowded to capacity with vesicles under great pressure and that the chorions are in mutual contact by large surfaces, he must wonder why anastomoses of the chorionic circulations do not more frequently occur. In this extreme crowding the marsupials are unique. It has occurred to the writer as highly probable that the shell membrane of marsupial eggs, far from being a useless vestige of Sauropsidan ancestry, serves to separate the vesicles until it is safe for them to come into immediate contact, if indeed they ever do. This point will be the subject of further investigation, as also the mechanism by which the male embryo is protected against the hormones of its mother and of its sister embryos. There being no placenta in the opossum, this organ is ruled out in this case.[5]

There is one condition, however, under which in the opossum fusion of the chorions is likely to occur, namely in twin eggs where two ova are included in the same egg envelopes. I have several such eggs in different stages of development.[6] A comparable case has been described for the rat where fusion took place between the trophoblasts of two eggs that became included in the same decidua.[7] Professor H. M. Evans, of the University of California, told the writer that among several hundred dog embryos of his collection he found one pair of very young twins within the same uterine swelling. The placentæ were fused (v.i.). These points raise interesting questions as to the mechanism by which the ova are usually distributed singly in oviduct and uterus.

The sex-intergrade of the opossum here pre-

[1] F. R. Lillie, *Jour. Exp. Zool.*, 23, 1917, 391–452.

[2] E. Steinach, *Pflüger's Archiv*, 144, 1912, 71–108 (see especially page 86).

[3] Lillie, *l. c.*, page 419.

[4] Lillie, *l. c.*, page 415.

[5] *Cf.* Lillie, *l. c.*, footnote, page 415.

[6] See Carl G. Hartman, *Jour. of Morph.*, 32, 1919. One twin egg may be seen in each of the batches shown in Fig. 4, Pl. 9 and Fig. 2, Pl. 1.

[7] V. Widakowich, *Zentralbl. f. Physiol.*, 24, 1910, 305.

sented furthermore corroborates in a striking manner the findings of Lillie (l.c.) and Chapin[8] that the hormone influence makes itself felt in the earliest stages of sex differentiation. That this must be so is proved by the fact that this animal is born ten days after fertilization and five days after the primitive streak stage.

Again, since in the specimen the cortex of the gonad is seen to be entirely absent we have here a confirmation of Lillie's statement that the gonad of the zygotic male, not possessing the homolog of the cords of Pflüger, is capable of less transformation than the embryonic ovary.[9] The absence of male sex cells in the specimen and the presence of healthy tubules (probably Sertoli cells only) is precisely in keeping with the theory of the influence of the female hormone in fetal life.

The assumption of certain embryologists that the embryo in the undifferentiated stage is a true hermaphrodite, is, therefore, no longer tenable.

More crucial evidence in favor of the view expressed above is, however, furnished by the following human case described by Eschricht.[10] It concerns a sex-intergrade which in all essentials was an exact counterpart of the opossum described above: externally, penis and empty scrotum; internally, uterus, Fallopian tubes with fimbriæ, and atypical "ovaries." It was a reciprocal free-martin, who, because of other malformation, died a few minutes after birth. The significant facts, however, in this human case are: (1) that *the child was born co-twin to a normal female* who lived and (2) that *the placentæ* were fused ("sehr genau verbunden"). Better proof could hardly be desired. I refrain from mentioning other human cases that must be interpreted as reciprocal free-martins, as, *e. g.*, those cited by Simpson.[11]

From the same article by Simpson it seems clear that the true free-martin also occurs in man. Such cases the author classifies with the free-martin of cattle, showing that he correctly interpreted them. This occurrence of both types in the same form (man) need constitute no great obstacle to the hormone theory, for it is quite conceivable that sometimes the male, sometimes the female co-twin gets the start in development, since the handicap need be very slight to prove ruinous to the laggard.

That the free-martin also occurs in rare instances in the dog, a multiparous animal, seems probable, since the "hermaphroditic dog" described by Home[12] in an apparently forgotten article is almost certainly a free-martin of the cattle type. In this connection the case of fused placentæ of the dog embryos found by Dr. Evans and cited above is of more than passing interest.

Free-martins, reciprocal free-martins and intermediate conditions may, therefore, be expected to occur in all mammals. The principle of hormone influence in fetal life, first demonstrated by Lillie,[13] constitutes the most important contribution to the subject as yet made. Twins and double monsters will have to be reclassified in the light of the theory[14] and such monographs as those of Sauerbeck and of Hübner[15] will have to be largely rewritten.

A more complete paper will be published later.

Carl G. Hartman
The University of Texas

[8] Catherine L. Chapin, *Jour. Exp. Zool.*, 23, 1917, 453–482.

[9] Lillie, *l. c.*, page 419.

[10] Eschricht, *Müller's Archiv*, 1836, 139–144.

[11] Sir J. Y. Simpson, article "Hermaphroditism" in Todd's Cyclopædia of Anat. and Physiol., 1836–39.

[12] Everard Home, *Phil. Trans. Roy. Soc.*, 1799, 162.

[13] See F. R. Lillie, Science, N. S., 50, 1919, 183–184.

[14] *Cf.* E. Steinach, *Archiv f. Entwicklungsmech.*, 42, 1916, 307–332.

[15] *Ergebn. d. allg. Path.*, 15, 1911.

THE NEBRASKA ACADEMY OF SCIENCES

The Nebraska Academy of Sciences held its thirtieth annual meeting at Doane College, Crete, Nebraska, on April 30 and May 1. The plan is to meet in Lincoln every other

year and at some other point in the state on alternate years. Usually the attendance is larger when the meetings are held in Lincoln as so many members are connected with the university and the Lincoln colleges. When held outside of Lincoln, there are usually interesting field trips and the smaller number makes possible a closer personal contact.

On Friday evening, the members were served the evening meal by the domestic science class. For the other meals, tables were set apart for the academy members at the college dining hall.

Following is the program:

Friday, 1:30 P.M.

Notes on the anatomy of Okapia johnsoni: H. V. Von W. Schulte.

The two classes of sperm in Rotifers: D. D. Whitney.

The use of the aeroplane in studying vegetation: P. B. Sears.

Equisetum gametophytes in Nebraska; A new species of Obedokonium: Edna R. Walker.

Root systems of cereal crops in the grassland formation: J. E. Weaver.

Dissemination of fungi with special reference to that of Sphærobolus and related forms: Lena B. Walker.

Pioneer tales from southeastern Nebraska. A sketch of Nebraska's early newspapers: Unice Haskins.

More western traditional songs: Louise Pound and Eleanor Burkett.

Racial elements in Nebraska population: A. E. Sheldon.

A scientific study of Czechoslovakia: Rose B. Clark.

The psychological clinic in practice: G. W. A. Luckey.

6 P.M.

Banquet and social hour.

8 P.M.

President's annual address, climate and evolution (illustrated.)

Saturday, 9 A.M.

Business Session.

10 A.M.

Some lessons in fuel conservation: J. C. Jensen.

Some investigations in the transmission of heat through boiler tubes: Jiles W. Haney.

Development of the telephone: V. L. Hollister.

Light and gravitation: H. H. Marvin.

At the business meeting final action was taken to affiliate with the A. A. A. S. and plans made to better organize the science work of the state. The following officers were elected:

OFFICERS

Dr. Elda R. Walker, *President.*
Professor A. J. Mercer, *Vice-President.*
Professor W. F. Hoyt, *Secretary.*
Dr. G. W. A. Luckey, *Treasurer.*
Lincoln Academy of Medicine.
Dr. E. G. Zimmerer, *Secretary.*

The executive committee held a meeting in Lincoln on August 28 and planned a campaign for membership. Members of the A. A. A. S. and of the N. A. S. will be invited to come in under the affiliated membership plan if they have not already done so. The final arrangements were made for the affiliation of the Lincoln Academy of Medicine with the N. A. S. The president announced the following appointments for sectional vice presidents:

SECTIONAL VICE-PRESIDENTS

Biological and Medical Science, Dr. R. A. Lyman.

Mathematical and Physical Science, Professor J. C. Jensen.

Ethnology and Folklore, Dr. Louise Pound.

Engineering, Professor George R. Chatburn.

Earth Science, Professor N. A. Bengtson.

C. O. Carlson

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.
NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

Friday, November 19, 1920

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE RESEARCH SPIRIT IN EVERYDAY LIFE OF THE AVERAGE MAN[1]

Research has been considered generally as a phase of effort quite distinctly set off from the natural course of human interest. It is my purpose to discuss the spirit or attitude of investigation as normally involved in the everyday working plans of the average person.

Of the significance of research in all fields of our endeavor the extraordinary advances and applications of science in the recent war have not left the world in doubt. For nearly half a century Germany had been known as a nation given to investigation in a great variety of little explored subjects, and governed in considerable measure in accordance with the results of such researches. The strength of German military organization, backed by scientific and economic interests welded into one powerful instrument, brought to all the Allied Powers full realization of the need for a supreme effort of intellect in many kinds of scientific and economic operation previously unknown. The result of this reaction was a stupendous contribution to application of research. Incidental failures, due to unpreparedness and to lack of organization, may not detract from the importance of what was thus produced.

No less clear is now in post-war reconstruction the evidence of need for entirely new views of old knowledge, for immediate answer to old questions not yet solved, and for quick results of investigation on problems of construction never before encountered. As had been predicted, we find ourselves to-day going forward to new plans of human organization, but more unsatisfactorily prepared for the complex situations of the new era than we

[1] Delivered as the address of the retiring president of the Pacific Division, American Association for the Advancement of Science at Seattle, Washington, June 17, 1920.

were for the more narrowly limited and clearly defined issues precipitated by sudden climax of war. Conflict such as that through which we have just passed intensified interest and brooked no delay in judgment. Reconstruction under peace conditions sets no precise time limits for its decisions. Therefore, we face to-day the settlement of great questions upon which the future of the world depends, but without that definite intention of judgment called forth by the immediate urgency of war-time crises. Our need for solving present vital problems requires a clear understanding of what the questions are and a determination of the responsibility for their solution. While we may assume that this responsibility rests more heavily upon some than it does on others, it is my purpose to call attention to the part which all thinking people have in the movement to bring these great issues to settlement.

In order that there be no misconception of the views presented, it should be clear that the interpretation of research in this discussion comprises not merely the detailed investigations of fundamental scientific principles, but with this includes all inquiry which may be included within the range of thought leading to constructive action. The mere acquisition of knowledge does not contribute unless it is carried on in such a relation that it leads ultimately to the process of building. On the other hand, construction can not go on without the process of investigation, as each new building operation involves an individual problem to be solved.

Some one has said that much of research—with the accent on the "re"—may be so called because after completion it becomes necessary with much labor to search it out again when real opportunity for use appears. Work of an investigational nature carried on with the right spirit, and with proper organization, should be planned to find its place without great loss of energy or time, or at least be located where, with other building materials, it lies at hand ready for use as required.

The research spirit represents a reaching out to understand and use all that lies about us. Its expression is as natural to a thinking mind as hunger is to stomachs. Its origin is by some compared to an awakening—in which we recognize the world of things about us but have come as yet only partially to know it. I prefer to think of it as identified with the growth tendency inherent in biological organisms, which may carry us on and on without limit, as our powers and range increase from age to age. Constructive work is inseparably a part of the living of intellectual life.

Much of misunderstanding that arises generally regarding the function and place of research relates itself to false conceptions, *first* of the limits of the broad field of knowledge, and *second* of the degree of stability in nature and in man as an outgrowth of the natural world.

An astonishingly large percentage of the human family conceives of available knowledge as comprising nearly all that may be known, and including much not worth knowing. Such views are not limited to uneducated persons, but have been found among scientific men accepting as final all present fundamental theories of the nature of matter, origin of the earth, relationship of life forms, and other equally critical interpretations of the natural universe. It has required the shock of many recent discoveries in physics, chemistry, astronomy and biology to make clear the fact that our understanding of much that is nearest to us is only imperfectly formulated; and that in the present period we can be assured of a field of the unknown, but not unknowable, about us so vast that realization to our ignorance makes us look only with humble pride upon past accomplishment. To such a field for endeavor as I have remarked for science there may be compared similar regions in the economic, governmental, and cultural subjects, toward which not only the student but the man of business and of affairs looks out with strong desire for attainment of much in knowledge that has not yet been reached. In our day the research of business on scientific lines bulks large in comparison with non-applied science, and present accom-

plishment has only stimulated the desire for further advance. Every evidence that we have indicates the wide open range for discovery of new principles and new applications of knowledge in practically every field which the intellect explores.

In an attempt to understand the need for continuous research activity, an acquaintance with the order of stability or instability in nature and in human affairs is hardly less important than a conception of the relatively narrow limits of attained knowledge. Human beings seem curiously inconsistent in that though they are stunted individually without constant growth or change, they attempt to deceive themselves into belief that an unchanging situation is the normal condition of nature. We calculate an average rainfall and expect it to rain just so many inches, be it 24 or 46 each year. We are shocked if it rains less. We see the rocks distorted and torn by countless movements dating through all past periods of earth's history, but we are surprised when a slip of a few inches disturbs the seeming present-day stability and produces an earthquake. We build highways of concrete and are astonished that they wear out. We write constitutions and expect the judgment of the men who made them to fit all times and conditions. Yet history shows us that with the law which states that nothing is completely destroyed, we must write with Pythagoras that nothing remains continuously the same. The geological book—the greatest historical document of all the ages—gives us as one of its truths the fact that in the known hundred or more million year record of life, nothing has remained in constant form; that the rule has been not only continuous change but also continuous advance of the highest level. Through vast periods man has himself been subject to changes like those that have been expressed in other living types; and the habit of nature so set forth seems to indicate that with the earth in continuous state of modification we may expect life and man to keep for the future a rate of growth not less rapid than that of past ages. Assured of the validity of these principles, we can be certain that as a race and as individuals we shall be almost continuously under the necessity of meeting adjustment and readjustment to new conditions. We have to face not merely the question of new knowledge which research should secure for the use of the moment, but with this we must have understanding which will guide and support us in the continuous movement incidental and evolutional which must be looked upon as the natural order.

With realization of the unattained limits of knowledge, and with the conception of continuously operating growth and readjustment to which we as individuals and as groups are subject, there comes to every person an understanding of the necessity for continuously operating constructive work. The giving of such a view as has been suggested is in my interpretation a necessary part of the broad function of education.

Education should not only give the wider and deeper view of the structure of knowledge, but with this it should furnish an acquaintance with the methods by which knowledge is obtained and applied. By one classification, educational work may be given five great purposes: (1) To determine our individual capacity for knowledge, and adaptability to special subjects; (2) acquisition of facts; (3) learning quality of judgment and organization of materials; (4) developing power to construct or create; (5) forming of character and development of altruistic motives. Education often concentrates itself on the acquisition of knowledge or of facts organized and unorganized, neglecting in considerable measure questions of capacity, training of judgment, constructive ability, and the development of character. Not without significance is an illustration in a recent publication representing a student with his arms piled full of books marked "knowledge," but unable to accept the volume of "wisdom" or judgment offered to him.

The third and fourth of the five points mentioned in the classification of educational aims, namely, judgment and creative ability, are in a large measure representative of re-

search. Though based upon the accumulation of facts, the critical significance of research lies in the quality of judgment and organization leading to constructive use, with the ultimate goal of application or service. One of the greatest contributions that education of the future can make is to place the emphasis in training on a broader view of organization of knowledge, on the ability to judge and construct, and on the desire for service. Not until such an understanding of the function of educational training comes into general acceptance, can we expect the average man to be brought into full participation or interest in the spirit and opportunity of the constructive work of the world required from day to day.

It is, I believe, also a responsibility of the educator to bring about a better understanding of the relation between the two great ideals of *construction* and of *service* which are fundamental to the philosophy of right living. Two groups of persons who contribute greatly to advance the comfort and happiness of mankind are, those who produce the new ideas upon which we build from age to age, and those who give themselves to public service in the larger sense. There is in my judgment a close and necessary connection between these two types of relations to the community. Research should lead to construction and is not complete unless the results are available for general use; while public service rarely attains the purpose for which it is initiated unless it is distinctly constructive.

I have spoken up to this time of the broader view of research, and of its more general relation to great problems with which we are confronted. In considering specifically the connection of this phase of thought with the life of the average man, we should look more particularly to the practical value of constructive work in contacts which may be considered representative of everyday life.

Research or constructive work is often divided into two types, one concerning fundamental principles without regard to their immediate application; the other, sometimes designated as research of application, representing especially the investigation of methods by which principles already known are put to human use.

The first type of investigation has been advanced especially in institutions concerned particularly with scientific and educational problems. Much fundamental investigation has, however, been conducted by engineering and governmental laboratories established specifically for the purpose of contributing to clearly determined needs. Through acquaintance with any one of many occupations such as agriculture, engineering, or business, the average person is sooner or later intimately in contact with some phase of this type of research.

Research of application reaches its highest expression in the great engineering laboratories of corporations recognizing the possibility of drawing from the field of investigation uses of scientific laws or principles, which may make possible great saving or higher efficiency in the conduct of their business. Enterprises organized for legitimate gain do not always make increased income by increased profit percentage, but often by increase in volume of business, introduction of new materials, or utilization of new ideas. Volume of business may mean increase of plant. The use of new materials often means a practical reorganization of plant and increased expenditure. Introduction of new ideas may mean increased efficiency, increased profit, and, with the exception of purchase of patents, may not require continued increase of expenditure.

Research of application finds general use in the problems of everyday business and everyday life, in which we are forced to make decisions which lie between following rule of thumb methods and the possibility of making a special judgment for every situation which confronts us. It is the difference between the attitude of the oculist or optician who has just so many possible standard types of cases into which all eye troubles can and must fit, and the other man who, under normal circumstances, considers each eye as different from every other and judges it specifically, accord-

ing to the fundamental laws of physics basic to his subject. It is the difference between the type of housewife who makes all pies in California according to the rules used by her grandmother in Maine, regardless of the character of the flour, or the kind of fruit; and the other housewife who, according to the materials involved and the end to be attained, judges through experience and experiment the combinations most acceptable.

The average man of intelligence comes to recognize in the course of his thinking that he lives in a world which we understand only imperfectly. At every turn he encounters the limits of his own knowledge and of our total accumulated store. In every kind of business or occupation he moves among those concerned with attack upon problems which are new in the general as well as in the individual sense. In some small part he is called upon to help in the solving of these questions. He is also expected to know how to secure information on problems which he needs to solve. In a still larger way he must understand the movement toward solution of economic and governmental question, in order that as a citizen he may exercise his privilege of giving intelligent support to those whose special work it is to investigate these matters and to pass judgment upon them.

It is a part of the duty of the average man to know the difference between pernicious questioning and constructive thinking; to judge what things of the established order should be left alone and which should now be changed. He must be a conservative, standing for stability, and yet recognize the constitutional evanescence of all things natural and human, and stand for progressive movements at critical times.

The average man must learn to know and value the contribution of the specialist or expert in constructive work, and call into his service men representing fields other than his own particular province. The habit of requesting properly organized investigation must be developed and put into operation in directions which show promise of leading to results of importance to the community interests.

The average man will do his research mainly in the field of application, rather than in studies of fundamental principles, but he will find the pleasures of constructive work outweighing in realization all other types of enjoyment. He will discover here a continuing interest which leads on with undiminished attraction and brings renewal of life stimulus.

As opposed to the life of constructive type, we may visualize the conservatism of habit in those individuals who fit themselves into the treadmill cycle of custom. Their individuality wears down to nothing, and they become only cogs in a machine of which neither the structure nor the purpose is seen. On the other hand, the constructive life means not alone continuous growth and unending youth, but it offers as well the largest opportunity for enjoyment of service. It furnishes the basis for that reaffirmation of individuality which both in science and in human service has been characterized as being born again. One who constructs and accomplishes sees new life. Those who follow blindly and without individual vision are sometimes known as of the practical type, and not infrequently pride themselves on refusing to accept the new which may be good and perpetuating in their life work the errors of their grandfathers, which the grandfathers would not thus have carried on.

Research and advancement of knowledge in the future depend not alone upon expressions of individual genius, nor upon opportunity for concentrated investigation in limited fields. The intelligent use of results of constructive work by the people as a whole, a general understanding of the methods by which this information has been obtained, and a knowledge of the means necessary to support research are also indispensable. Great advances of the future are not dependent upon having every man do everything as an expert, but they will rest upon a wide appreciation of the importance of constructive thought, of organized knowledge, and of the need for continuous advance of knowledge.

Education will play a large part in the support of research through giving, even in

elementary courses, the proper view of knowledge and an understanding of the means by which it grows. Nothing would probably go farther toward bringing us to a satisfactory view of our present situation than a course of instruction on that which we do not know, but which might by investigation become known. With this there should go a presentation of evidence as to the methods by which constructive work could bring this information and apply it.

A great responsibility for realization of the possibilities in education rests upon those scientific organizations which have given themselves especially to the problems of constructive thought. Through the scientific institutions which we represent, it is our duty to make clear the function of education to train in judgment and construction rather than to encourage merely the amassing of facts. A responsibility rests upon us to see also that the results of our own investigations are not buried more deeply than were the materials upon which they have been based. New ideas should be clearly recognized, fully stated, and placed where the applying engineer may find the data which he requires to meet human needs. We have again a duty, so to organize our work that other investigators and applyers may not only know the results, but that they may cooperate with us to mutual benefit.

There is no doubt that properly organized and coordinated efforts of science and education may increase greatly the present opportunity of the average man for constructive activity, making his life more useful and happier. The average man of the future will of necessity live his life largely in a routine based upon customs of the prevailing social order. He will give himself to action governed by established rules formulated from experience; but always and increasingly in his individual affairs, as in his relation to the community, he will find his largest measure of satisfaction in the building type of effort originating through his own thinking. As the product of the life work of each individual accumulates, the evidence of true individuality will become more clear, until there emerges from the chrysalis stage of mere physical and mental separateness the newborn personality of one who in creating an idea has given to himself the right of eternal individual recognition as an intentional participant in human progress.

As the problems of community organization become more clearly visualized, the importance of the research or constructive spirit in the average man will increase, and the future of democracy depends in a measure upon the possibility of securing for each capable person an opportunity to obtain the wider view of the greater problems, to learn dependence upon those who know and are true, and with all this to make contribution in an unselfish spirit. Unless these objects are realized we are doomed to revolve without progress through endless cycles of misunderstanding and conflict.

Education with its varying emphasis on the fundamental truths of science, philosophy, human relations and religion is our principal safeguard. Our definite guarantees of progress are found in the lessons of history, taken with the present wide expression of individual responsibility for judgment in the critical affairs of citizenship.

John C. Merriam

DOCTORATES CONFERRED IN THE SCIENCES BY AMERICAN UNIVERSITIES IN 1920

A compilation of the doctorates conferred by American universities has been made for each year from 1898 to 1916, and the data published in Science annually through 1915 and in *School and Society* for 1916. Dr. Burg, who compiled the last annual statistics, severed his university connection in 1917 and the compilation was turned over to someone else who for various reasons was unable to complete the work. No statistics, therefore, are available for 1917–18 and 1918–19, but the compilation has been resumed for the academic year 1919–20 in so far as the doctorates conferred in the sciences are con-

cerned, and the comparison with previous years indicates that conditions affecting doctorates have regained a normal state. There has been no increase in the number conferred, nor any considerable decrease.

In 1920 there were 328 doctorates conferred in the natural and physical sciences by 31 institutions. In 1916 there were 332 conferred by 28 institutions. It is interesting to note that the small decrease in the number of degrees conferred is practically equalled by the small increase in institutions conferring them. Those institutions which have always been at the head of the list have changed their order in some cases, but are still leading. However, the degrees seem to be more widely distributed than formerly. The University of Chicago continues to confer the largest number of degrees, while Cornell University takes second place. As usual, the eastern universities lead in numbers conferred, though the western and middle western institutions follow very closely with only 14 less. Johns Hopkins University dropped from 23 in 1915 and 22 in 1916 to 17 in 1920, and Harvard rose from 16 in 1916 to 28 in 1920. Wisconsin and Illinois have taken their places in the first group, with 24 and 22 degrees respectively. There were 14 universities conferring degrees in the past which conferred none this year.

Chemistry continues to head the list of subjects in which the doctorates were conferred, though with not so large a number as in 1916, nor so great a per cent. of the total. In 1916 there were 115 conferred in chemistry and in 1920 there were 96. Small gains in many of the other sciences bring up the total. The most noticeable gain is in psychology, which has risen from 22 in 1915, and 19 in 1916 to 40 in 1920. No doctorates were conferred specifically in paleontology, mineralogy, metallurgy or meteorology.

A list of the names of the recipients of the doctorates with the titles (sometimes abridged) of their theses has been made, classified by the subject in which the degree was conferred, and grouped under the subject according to the university conferring them.

DOCTORATES CONFERRED IN THE SCIENCES IN AMERICAN UNIVERSITIES

	'12	'13	'14	'15	'16	'20
Chicago	37	16	28	53	53	59
Cornell	28	30	36	26	24	35
Harvard	15	22	28	33	16	28
Columbia	36	27	21	27	34	24
Wisconsin	14	5	17	8	22	24
Yale	21	19	13	20	24	23
Illinois	15	11	18	17	26	22
Johns Hopkins	23	21	18	23	22	17
California	12	9	11	16	17	14
George Washington	2	1	2	4	5	9
Michigan	8	10	5	15	10	9
Princeton	7	7	7	4	19	9
Ohio	5	0	0	1	2	6
Indiana	4	1	2	4	3	5
Iowa	3	2	2	2	2	5
Mass. Tech.	6	1	2	2	3	5
Pennsylvania	9	9	5	11	16	5
Clark	6	13	7	10	9	4
Minnesota	2	2	3	4	7	4
Stanford	3	5	2	2	0	4
Brown	4	1	4	5	2	2
Cincinnati	1	2	2	0	2	2
Missouri	0	1	1	1	3	2
Pittsburgh	1	5	0	4	0	2
New York	2	3	1	3	0	2
Syracuse	0	0	0	0	0	2
Bryn Mawr	3	0	2	0	3	1
Catholic	1	0	0	2	1	1
Kansas	0	0	0	0	0	1
Radcliffe	0	0	0	0	0	1
Virginia	2	2	1	0	2	1
Total	273	234	241	309	332	328

DOCTORATES DISTRIBUTED ACCORDING TO SUBJECTS

	'12	'13	'14	'15	'16	'20
Chemistry	78	68	71	85	115	96
Botany	30	28	34	40	36	47
Psychology	29	24	12	22	19	40
Zoology	20	26	25	32	33	38
Mathematics	22	21	25	23	34	20
Physics	30	22	23	31	35	20
Geology	23	14	13	26	17	16
Physiology	12	2	8	8	14	14
Agriculture	11	8	9	9	6	8
Bacteriology	6	3	6	4	4	7
Astronomy	2	11	2	7	6	6
Engineering	2	0	4	2	2	5
Anatomy	6	1	2	5	1	3
Geography	0	1	0	3	3	3
Pathology	2	2	1	2	2	3
Anthropology	0	3	2	6	1	2
Paleontology	0	0	4	2	3	0
Mineralogy	0	0	0	1	0	0
Metallurgy	0	0	0	1	1	0
Total	273	234	241	309	332	328

THESES DISTRIBUTED ACCORDING TO SUBJECT

Agriculture

CORNELL: Roy Glen Wiggans, "Classification of the cultivated varieties of barley." Daniel Scott Fox, "Analysis of the cost of growing potatoes." Frank App, "Farm profits on 370 potato farms in Monmouth, New Jersey."

ILLINOIS: Jose Jison Miralsol, "Aluminum as a factor in soil acidity."

MINNESOTA: Paul Harmer, "Uniformity of the Late Gray Drift of Minnesota."

WISCONSIN: William Merriott Gibbs, "Isolation and study of nitrifying bacteria." Tsunao Inomata, "Intensity of culture." Frederick Charles Bauer, I. "Effect of leaching on the availability of rock phosphate to corn." II. "Relation of organic matter and the feeding power of plants to the utilization of rock phosphate."

Anatomy

CHICAGO: Luther Sherman Ross, "Cytology of the large nerve cell of the crayfish (*Cambarus*)."

CORNELL: Lyda May Degener, "Development of dentary bone and teeth in the lower jaw of *Amia calva*."

HARVARD: Ralph Faust Shaner, "A study in comparative embryology."

Anthropology

COLUMBIA: Leslie Spier, "The Sun Dance of the Plains Indians."

HARVARD: Edward Smith Handy, 3d, "Polynesian religion."

Astronomy

CALIFORNIA: Sophie Hazel Levy, "Theory of motion of the planet (175) Andromache." Charles Donald Shane, "The spectra of certain class N stars."

CHICAGO: Alice Hall Farnsworth, "Comparison of the photometric fields of the 6-inch doublet, 24-inch reflector, and 40-inch refractor with some investigation of the astrometric field of the reflector." Hannah Steele Pettit, "Proper motions and parallaxes of 359 stars in the cluster *h* Persei." Edison Pettit, "Form and motions of the solar prominences."

MICHIGAN: Julia May Hawkes, "Photographic determination of the positions of stars and nebulous knote in and around the great nebula of Andromeda."

Bacteriology

CALIFORNIA: Theodore Day Beckwith, "Studies upon the chemotherapy of the experimental typhoid carrier condition."

CHICAGO: Ida Albertina Bengtson, "The proteus group of organisms." Benjamin Junior Clawson, "Varieties of streptococci with special reference to constancy."

HARVARD: Monroe Jacob Schlesinger, "The mechanism of antianaphylaxis."

NEW YORK: Hassow Otto Von Wedal, "Complement fixation test for tuberculosis."

OHIO STATE: Edward Everett Hale Boyer, "The chemical nature of the antigenic substances in Bacillus coli."

YALE: William Shelton Sturges, Jr., "Bacterial autolysis."

Botany

BROWN: Eda May Round, "Carboniferous flora of Rhode Island."

CALIFORNIA: Carl Hartley, "Damping-off in forest nurseries."

CHICAGO: Arthur Wing Haupt, "The life-history of *Fossombronia cristula*." Ladema Mary Langdon, "Stem anatomy of *Dioon spinulosum*." John James Willaman, "Function of vitamins in the metabolism of *Sclerotinia cinerea*." Dean Alvin Pack, "After-ripening and germination of juniper seeds." Scott Verne Eaton, "Sulfur content of soils and its relation to plant nutrition." Hope Sherman, "The respiration of dormant seeds." Perry Daniel Strausbaugh, "Study of dormancy in the plum." Helen Ashhurst Choate, "Study of certain chemical changes occurring in wheat during germination." Howard DeForrest, "Plant ecology of the Rock River Woodlands of Ogle County, Illinois."

COLUMBIA: Frederick Vernon Rand, "The chloratic groups of plant diseases with special reference to pecan rosette." Robert Aaron Steinberg, "Stimulation of growth by zinc and ferric sulphates." Harvey Earl Thomas, "Relation of the health of the host and other factors to infection of *Opium graveolens* by *Septearia apiirosti*."

CORNELL: William Henry Eyster, "Linkage relations of the factors for tunicate ear and starchy-sugary endosperm in maize." Ernest Gustaf Anderson, "Inheritance of salmon silk color in maize." Vining Campbell Dunlap, "Studies of development in the genus *Pleurotus*." Edwin Fraser Hopkins, "The botrytis blight of tulips." Harry E. Knowlton, "Studies in pollen." Roy David Anthony, "Sexual inheritance in the violet." Harvey Elmer Stork, "Biology, morphology and cytoplasmic structure of *Aleu-*

rodiscus." Harry Wilmer Dye, "The bottom-rot and the stunt." Gordon Peter McRostie, "Inheritance of disease resistance in the common bean." Frank Burkett Wann, "Fixation of free nitrogen by green plants."

George Washington: William Edwin Safford, "Revision of the genus *Datura*."

Harvard: Oran Lee Raber, "Effect of anions upon permeability." Alden True Speare, "Morphology and reproduction of *Sorosporella uvella*."

Illinois: Lee Ellis Miles, "Leaf spots of the elm." Mary Emma Renich, "Growth as related to specific gravity and the size of seed." Edwin Rollin Spencer, "Some of the causes of decay of Brazil nuts." Truman George Yuncker, "Revision of the North American and West Indian species of *Cuscuta*."

Iowa State: Beryl Taylor, "Development of foliage leaves of *Vitus vulpina* L. and *Catalpa bignonoides* (Walt.).

Johns Hopkins: William Ernest Seifriz, "Structure and behavior of protoplasm as determined by the aid of microdissection."

Michigan: Ray Clarence Friesner, "Daily rhythms of elongation and cell-division in certain roots." Frieda Cobb, "Case of mendelian inheritance complicated by heterogametism and mutation in *Œnothera pratincola*."

Ohio State: Swarna Kumer Mitra, "Toxic and antagonistic effects of salts on *Saccharomyces ellipsoideus*."

Pennsylvania: William Randolph Taylor, "Morphological and cytological study of reproduction in the genus *Acer*." Irwin Boeshore, "Morphological continuity of Scrophulariaceæ and Orobanchaceæ."

Pittsburgh: Earnest Milton Gress, "Grasses of Pennsylvania."

Radcliffe: Matilda Moldenhauer Brooks, "Quantitative studies on the respiration of *Bacillus subtilis* (Ehrenberg) Cohn."

Wisconsin: Clyde Melvin Woodworth, "Inheritance studies in soy beans. I. Cotyledon, seed-coat, hilium, and pubescence colors." Bert Lorin Richards, Title of thesis not given. William Burley Tisdale, Title of thesis not given. Walter H. Snell, Title of thesis not given. Edward Eastman Clayton, "Influence of certain environmental factors on the development of the fusarium wilt of tomatoes." Mabel Mary Brown, "Distribution of sexual characters and regeneration in *Funaria hygrometrica* (L) Sibth."

Yale: Julia Bayles Paton, "Pollen and pollen enzymes."

Chemistry

Brown: Chester Lewis Knowles, "Preparation of para dephenyl propiolic acid."

California: John Merritt McGee, "Preparation and properties of sodium amide." Roy Frederick Newton, "Equilibria in reactions of methyl alcohol with hydrochloric acid and with hydrobromic acid." George Sutton Parks, "The specific heats of ethyl and propyl alcohols."

Chicago: Ray Quincy Brewster, I. "Symmetrical tetraprophylethane." II. "Reduction of nitrotriphenylamine." Elvah Harley Grafton, "The adsorption of benzene derivatives on the surface of water." Morris Selig Kharasch, "Colors of the second order." George Elmer Miller. I. "Preparation of pure cyanogen chloride. II. Preparation and study of d- and l-beta gamma diozybutyric acid." Charles H. Milligan, "The preparation of d-l-P-methyl-isopropyl methyl-phenyl hydrazine. The isolation of pure d-P-methyl-isopropyl methyl-phenyl aniline." Henry John Rosebacher, "M-tolyl-ethyl-barbituric acid." Karl Theodor Steik, "The effect of alkali upon Portland cement." Roger John Williams, "The vitamine requirement of yeast." Lathrop Emerson Roberts, "A study of phase boundaries." Amando Clements, "The relation between pore size and adsorption in charcoal." Mary Meda Rising, I. "The preparation of phenylethylbarbituric acid. II. The preparation of para-ureido-phenylacetylurea and related compounds. III. An attempt to filter the enzymes of milk." John Edward Schott, I. "Oxidation of benzamide. II. Derivatives of phenylethylbarbituric acid." Dwight Tarbell Ewing, I. "The densities and adsorption and desorption properties of gas mask charcoals. II. The effects of acids and bases on the surface energy of B-B-dicolorethyl sulphide ('Mustard gas')." Steward Basterfield, "Derivatives of isourea and their pharmacological action." Ying Chang Cheng, "Cohesion, adhesion, tensile strength, tensile energy, negative surface energy, interfacial tension, and molecular attraction." Frank Louis DeBeukelaer, "Derivatives of phenylethylacetic acid and of phenyldiethylacetic acid." Warren Walter Ewing, "Attractions of mercury for other liquid." Louis Melvin Larsen, I. "Nitrotriphenylamines. II. Oxidation of diaminophenols."

Cincinnati: Clarence Alonza Mills, "Distribution, nature and method of action of tissue coagulants."

Clark: Chung Yen Chiu, "Nature of the complexes formed between the alkali metals and certain heavy metals in liquid ammonia." Henry Cole Parker, "Conductance of iodic acid in aqueous solution."

Columbia: Eliz Brakelly, "Factors affecting the stability of addition compounds in solution and their influence upon viscosity." Paul Maymes Gross, "Factors affecting the stability of addition compounds in solution and their influence on ionization-equilibria." Theodore Clinton Taylor, "Fat associated with starch." Marguerite Wayman, "The effect of certain antiseptics upon the activity of amylases." Francis J. Fuchs, "Effect of foreign oxides upon the decomposition of silica oxide, mercuric oxide and barium peroxide." Paul M. Giesy, "Chemical study of the placental harmone." Mary Louise Landon, "Formation of addition compounds between 100 per cent. sulphuric acid and the neutral sulphates of the alkali metals." Ida Pauline Rolf, "Contributions to the chemistry of the unsaturated phosphatids."

Cornell: Frank William Douglas, "Chemistry of germanium." Ralph W. G. Wyckoff, "Crystal structures of caesium dichloroiodide and of sodium nitrate." Major Edward Holmes, "Contributions to the chemistry of the hydronitrogens and pernitrides."

George Washington: Elias Elvove, "The detection and estimation of small amounts of organic nitro compounds with special reference to the examination of the urine of TNT workers." Edward Elmer Smith, "The effects of bleaching with oxides of nitrogen upon the baking qualities and commercial value of wheat flour." Peter John Donk, "A thermophilic bacterium causing flat-sour in canned goods."

Harvard: Edward Adelbert Doisy, "Determination of sodium, potassium and chlorine in small samples of tissue." Webster Newton Jones, I. "Study of 1, 2-dibenzoyl-3-phenylcyclopane. II. 1-Iod-2, 4, 6-tribrom-3-nitrobenzene. III. 2, 2, 3-trimethylpentane." Alexander Donald Macdonald, "Addition of phosphorus trichloride to saturated aldehydes and ketones." David Robert Merrill, I. "On catalytic oxidation. II. On certain cyclopropane derivatives."

Illinois: Miner Manly Austin, "Potash in Illinois shales." Herbert Ephraim French, "Preparation of substituted alpha halogen benzyl benzoates, and a study of the reactions of these compounds." Ralph William Hufferd, "Application of Victor Meyer's esterification law to neighboring xylic acid and its reduced derivatives." Carl Shipp Marvel, "Study of the possible asymmetry of the aliphatic diazo compounds." Ruth Evelyn Merling, "Methods of arylaton." Sargent Gastman Powell, "Unsaturated phenyl ethers and their rearrangements." Lynne Herman Ulich, "Reactions between acid halides and aldehydes." William Alexander Van Winkle, "Study of the determination of the halogens in volatile organic compounds."

Johns Hopkins: Frederick Keller Bell, "Effect of copper on the solubility of iron in acids." Charles Edward Lanning, "Study of an oxidizing catalyst." Edward Otis Holmes, Jr., "Action of ultra-violet light on gels." Frederick Collins Lee, "Electrolytic preparation of ammonium permanganate." Paul Lange Lotz, "Osmotic pressure of sucrose 30° and 55°.7 as determined by the water interferometer." George Edgar Miller, "Anthraquinone, 1, 8 aliphatic thioether-sulphonic acids and di-thioethers." Colin MacKenzie MacKall, "Anthraquinone 1, 5 aliphatic thioether-sulphonic acids and di-thio-ethers." Charles Snowden Poggott, "Catalytic oxidation of ammonia." Lloyd Hilton Reyerson, "Nature of the interfaces existing in the pores of silica gel and the retention of bromine by silica gels." Thomas Cobb Whitner, Jr., "Study of the reactions of normal butyl mercaptan and some of its derivatives."

Massachusetts: James Alexander Beattie, "Investigations in the electromotive forces of concentration cells of lithium and potassium chlorides." Ming Chow, "Investigations in the electromotive forces of concentration cells of potassium hydroxide, and on the activities of ions in mixed electrolytes." Yu Liang Yeh, "Investigations of liquid junction potentials, and on the activities of ions in mixed electrolytes." Charles Ernest Ruby, "Investigations of the equilibria and free energies of mixtures of manganate, permanaganate, and hydroxide of potassium and manganese dioxide."

Michigan: Dorothy Hall, "Separation of copper and cobalt by phenythiohydantoic acid and the volumetric determination of cobalt." Earl Grover Sturdevant, "Electrodeposition of brass from cyanide solutions."

New York: Irene Caroliner Diner, "Microscopic examination of rubber and rubber products."

Ohio State: Frank Carl Vilbrandt, "Oxidation of

methane." Melvin Guy Mellon, "Further study of a lead standard cell."

Pittsburgh: Emil Harold Balz, "Derivatives of 2, 4, 6, trinitrobenzaldehyde."

Princeton: Arthur Ferguson Benton, "Gas flow meters and the end correction in the determination of gas viscosity by the capillary tube method." Homer Hiram Lowry, "Studies in the absorption by charcoal." Merwyn Clarence Teague, "Efficiency, testing and improvement of gas warfare box respirators."

Virginia: Judson Hall Robertson, "Hydrolysis and heat of formation of urea sulphate, and the relation of these factors to the decomposition of urea into ammonia and carbon dioxide in aqueous solutions."

Wisconsin: George J. Ritter, "Catalytic hydrogenation of cotton seed oil." Van Lorens Bohnson, "Contribution to the study of the catalytic decomposition of hydrogen peroxide." Barnett Sure, Title of thesis not given. Wallace Headen Strowd, "Studies in the nitrogen metabolism of the soy bean." Daniel Christopher Leander Sherk, "Thymol and carvacrol problems in connection with the Monardas." George Robert Shaw, "Chemistry of platinum at high temperatures and pressures." Clifford Shattuck Leonard, Title of thesis not given. Clinton B. Clevenger, I. "The accurate determination of the hydrogen-ion concentration of plant juices by means of the hydrogen electrode. II. Factors affecting the acidity of hydrogen-ion concentration of plant juices."

Yale: Charles Barkebus, "Some constituents of *Viburnum Prunifolium* or Black Haw." Stuart Robert Brinkley, "Equilibrium in the system ammonia-ammonium nitrate-ammonium thiocyanate." Florian Anton Cajori, "Nutritive properties of nuts." John Joseph Donleavy, "Alkylation of aromatic amines by interaction with aliphatic alcohols." Jacob Benjamin Fishman, "New derivatives of benzylalcohol possessing possible therapeutic interests." Martha Richardson Jones, "Studies on carbohydrate metabolism in rabbits." Frederick William Lane, "Study of certain alkyl derivatives of resorcinol and their value as antiseptics." Walter Gerald Karr, "Studies on nutrition." Icie Gertrude Macy, "Comparative studies on the physiological value and toxicity of cotton seed and some of its products." Lyman Edwards Porter, "Analytical chemistry of gallium." George Walter Pucher, "Development of the intermediate stages of a new method of synthesizing histamine." Arthur Henry Smith, "Effect of solutions of certain salts and colloids on the permeability of the capillary walls."

Callie Hull,
Technical Assistant
Research Information Service,
National Research Council

(*To be concluded*)

THE LOW TEMPERATURE LABORATORY OF THE BUREAU OF MINES

On June 17, 1920, Professor J. C. McLennan, of the University of Toronto, gave a lecture before the Chemical Society in London, on "Helium, Its Production and Uses." This lecture has been printed in the July, 1920, number of the *Journal of the Chemical Society*. At the close of his lecture Professor McLennan gave special emphasis to the great need of a properly equipped cryogenic laboratory somewhere within the British empire. To quote his own words:

> The list of problems rendered capable of attack by the use of liquid helium might be easily extended, but those cited already will serve to show that the field is large and that it is well worth while for us to make a special effort to secure adequate financial support for the equipment and maintenance of a cryogenic laboratory within the Empire. It is probably beyond the ordinary resources of any university to equip and maintain such a laboratory, but the project is one which merits national and probably imperial support. It should appeal to private beneficence as well for it is a project deserving strong and sympathetic help.

It may be of interest to American scientists to know that the need of such a laboratory in this country was recognized by the Bureau of Mines more than a year ago. The immediate need was for the obtaining of certain scientific data which is necessary for the improvement and development of the commercial work in connection with the government helium plants, but there is a large field outside of this immediate need which can be covered by such a laboratory.

Through the interest and broadmindedness of Commander A. K. Atkins, of the Navy, and Colonel C. DeF. Chandler and Lieutenant R.

S. Olmsted, of the Army Air Service, necessary funds for the purchase of equipment and the maintenance of this laboratory were furnished to the Bureau of Mines late last spring. This equipment is now being received and installed by the Bureau of Mines in the New Department of the Interior Building at Washington. The equipment consists of two four-stage Norwalk compressors with a capacity of 75 cu. ft. of free air per minute each. These will be used for making liquid air and for other purposes in connection with the experimental work. There will also be one vertical submarine type Norwalk compressor with a capacity of 12 cu. ft. of free air per minute to be used in connection with a liquid hydrogen cycle, and a similar compressor with a capacity of 8 cu. ft. of free air per minute for use in connection with a liquid helium cycle. These compressors will all be driven by variable speed motors, and be equipped with unloading valves so that the capacities can be varied within wide limits. In addition, there will be an adequate equipment of gas holders, a machine shop, and a chemical and physical laboratory. The force will consist of four technical men and two mechanics, and the whole laboratory will be under the direction of the writer. It is hoped that the equipment will be completely installed by January 1.

Whereas the main object of the laboratory will be to assist in every possible way the whole helium project, both on the production and refining ends, there is a strong desire that this laboratory shall be of material use to science in general, and that it may be possible later on to make arrangements for its facilities to be used in special cases by men outside the government service who are specially equipped for such work.

R. B. Moore

SCIENTIFIC EVENTS

PHOSPHATE IN MOROCCO

In times of peace this country, according to the Geological Survey, has in a single year sent abroad, mostly to Europe, 1,250,000 long tons or more of high-grade phosphate rock, or more than 40 per cent. of its total annual output. The exports decreased during the war until, in 1918, they amounted to only 143,000 tons, or 6 per cent. of the domestic output. They increased to 379,000 tons in 1919, but these reports of newly discovered large deposits in Morocco, which, like those in Algeria and Tunis, are near to the large fertilizer market in southern Europe, may mean that the American exporter of phosphate rock will have formidable competition in that region.

As superphosphate fertilizer is manufactured chiefly from phosphate rock, France, by her control of the deposits in Algeria, Tunis and Morocco, has a practical monopoly of the North African sources of a commodity that is essential to the restoration of European agriculture. When these deposits have been further developed and adequate transportation facilities have been provided the market for phosphate rock in southern Europe will probably be supplied from northern Africa, so that the American exports to Europe will be confined to the northern countries.

The principal deposits in Morocco are about 80 miles southeast of Casablanca and consist of three beds or series of beds of phosphatic sand in a formation that is 50 to 200 feet thick. The uppermost phosphatic bed contains 67 per cent. of tricalcium phosphate, the middle bed 30 per cent. and the lower beds 53 per cent., and the commercial average for the group is about 59 per cent. Water and hydroelectric power for the exploiting of the deposits can be obtained from a river near by. In order to market the rock, however, a railroad would have to be built from the deposits to Casablanca, the nearest port.

Another deposit, which consists of soft phosphatic material carrying 72 to 75 per cent. of tricalcium phosphate, lies 40 miles northeast of the principal one. Still another deposit lies a short distance southeast of Rabat, a coast town. This deposit consists of sandy clay 16 feet thick containing nearly 47 per cent. of tricalcium phosphate.

THE PASTEUR INSTITUTE OF PARIS

The Paris correspondent of the *Journal* of the American Medical Association writes:

A touching appeal for the cause of microbiologic research was recently made by Dr. Charles Nicolle, director of the Pasteur Institute of Tunis, in a letter published in the *Temps*. He had just completed a stay of two months in France, and he returned appalled at the conditions which he found. The country which has produced Pasteur, Duclaux, Laveran and Roux, to mention only a few of the more illustrious scientists, and which received Metchnikoff with open arms, without the least compunction is permitting the decline of a science that has given France a large part of her past glory and from which she has always derived the first benefits.

Nicolle admits that it would be unfair to demand that the state support the laboratories, especially at the present time. However, he thinks that it is not the teaching laboratories from which we should expect to see great discoveries come forth: he who teaches is an erudite, while the mentality of the research worker is entirely different, and it is through other than teaching institutions that all real progress in microbiology must come. The typical institution of this kind in France and the one most widely known is the Pasteur Institute of Paris, the parent establishment whose offspring may be found in France, the colonies and abroad. The Pasteur Institute is a private establishment and does not serve as a teaching medium. The members of its staff devote all their efforts to scientific investigations, and in the thirty-five years of their endeavors they have shown marked ability. The institute derives its income from the sale of biologic products and from donations, and to-day neither of these sources furnishes ample means. Not having the inexhaustible resources of the government back of it, it is now merely vegetating, and it is only by a miracle that more can be accomplished.

Nicolle, therefore, addresses to the public an appeal for support of the microbiologic laboratories, pointing out that the matter should be of special interest to the farmers, for instance, for it makes possible a continuation of the researches on aphthous fever, a disease that has been responsible for the loss of millions and constitutes a permanent menace to agriculture. On the other hand, Nicolle calls attention to the difficulty of inducing young men to enter the laboratories, for the small budgets make a career in a laboratory anything but profitable.

THE BRITISH MINISTRY OF AGRICULTURE

Nature states that changes are announced at the British Ministry of Agriculture, the effect of which is the promotion of Mr. F. O. L. Floud to be permanent secretary and the liberation of Sir Daniel Hall from office work so that he will be able to keep in close personal touch with agricultural developments and devote his whole time to the organization of agricultural education and research. The scheme now in operation comprises four essential parts: (1) Research institutions, where knowledge is gained and agricultural science systematically developed and put into such form that teachers and experts can use it. At first this work was distributed among a number of university departments, but of recent years there has been a tendency to concentrate it at a few institutions owing to the necessity for bringing individual workers into closer personal contact with each other and with the large-scale problems of the farmer. (2) Agricultural colleges, where experts and large farmers will be trained, receiving a three years' course of instruction of university character. Most of these colleges are associated with universities which award degrees in agriculture; for students who do not wish to take degrees there is a diploma course requiring a high standard of technical work. (3) Farm institutes for small farmers and farm-workers who can not spare three years for college, but have some practical knowledge and are unable or unwilling to go through the ordinary college course. These institutes aim at giving sound courses of instruction on soil, manure, crops, animal husbandry, etc., but it is usually presumed that the student will take up farming in the area served by the institution, and for which the instruction is specially appropriate. (4) Advisory officers. In each county arrangements are made whereby farmers, smallholders, and others may consult the agricultural expert appointed by the county authority in regard to any difficulties they may meet with in their work. The expert is in a position somewhat similar to that of the general medical practitioner, and usually finds that he can deal with a large number of the cases presented to him. He is, however, in touch with the colleges, research institutions, etc.,

and can always obtain expert advice in any particular problem of special difficulty.

COLLECTION OF BIRDS FOR THE CALIFORNIA ACADEMY OF SCIENCES

ANOTHER well-known ornithological collection has been added to the rapidly increasing collections in the Museum of the California Academy of Sciences, San Francisco, California—the W. Otto Emerson collection.

Mr. Emerson began his bird studies in California some forty years ago, at that time laying the foundation of one of the most complete local collections of birds assembled in this state. His studies have been maintained in his spare time to the present date, and the results of his bird studies and observations are apparent in his notes and carefully selected series of specimens of local species. As Mr. Emerson has lived at Hayward, Alameda county, California, practically all of this period, his collection and notes have especial value from the standpoint of local occurrences, distribution, changes, etc.

In this collection are some most useful series of ducks in the first stage of juvenile plumage, carefully identified, which, added to such material as is adready in the academy collection, will be of much value for comparisons, and the study of plumage. Besides the series of birds of especial local value, there are a good series of warblers from various parts of the United States, and some rare records from California in the line of warblers, and some original record specimens for the state of several species of sparrows, etc.

The academy suffered the loss of its very valuable collection of birds in the fire of 1906, and, while the series of sea and shore birds has been more than replaced, the land birds have had but little effort expended upon them. The addition of the Emerson and Mailliard collections, which consist principally of land birds, has very materially assisted in bringing the academy collection nearer to its old basis.

In addition to the collection of bird skins, some valuable manuscripts of Dr. James G. Cooper, such as those of "The Ornithology of California, Land Birds, 1870," and "The Birds of Washington Territory, 1860-65," together with some of Dr. Cooper's note books, dating back to 1853, have accompanied the collection.

THE GEOLOGICAL SOCIETY OF AMERICA

THE thirty-third annual meeting of the Geological Society of America will be held Tuesday to Thursday, December 28 to 30, at Chicago by invitation of the University of Chicago and in affiliation with the American Association for the Advancement of Science. The scientific sessions will be held in Rosenwald Hall on the university campus.

The address of the retiring president, Dr. I. C. White, will be delivered in the Reynolds Club building at 8 o'clock P.M., Tuesday, December 28, 1920. The annual subscription smoker will be held at the Reynolds Club at the conclusion of President White's address. Tickets, $1.00 each. The annual subscription dinner will be held at the Chicago Beach Hotel, 51st Street and Lake Michigan, Wednesday evening, December 29, at 7 o'clock. Hotel headquarters will be established at the Chicago Beach Hotel.

The Paleontological Society will hold its twelfth annual meeting at Chicago in conjunction with the Geological Society of America. Full information regarding this meeting may be obtained, as usual, from the society's secretary, Dr. R. S. Bassler, U. S. National Museum, Washington, D. C.

The Mineralogical Society of America will hold its second annual meeting at Chicago in conjunction with the Geological Society of America. Full information regarding this meeting may be obtained from the society's secretary, Mr. H. P. Whitlock, American Museum of Natural History, New York City.

The Society of Economic Geologists will hold its initial meeting at Chicago in conjunction with the Geological Society of America. For further information regarding this meeting, address Professor J. Volney Lewis, secretary, New Brunswick, N. J.

EDMUND OTIS HOVEY,
Secretary

AMERICAN MUSEUM OF NATURAL HISTORY,
NEW YORK,

SCIENTIFIC NOTES AND NEWS

ACCORDING to a cablegram from Stockholm to the daily press, Charles Edouard Guillaume Breteuil, head of the International Bureau of Weights and Measures, was awarded the Nobel prize in physics for 1920 on November 11 by the Swedish Academy of Science. The prize in chemistry has been awarded to Professor Adolf Ossian Aschan, of Helsingfors University in recognition of his researches in connection with the production of synthetic rubber. The award of Nobel prizes to Professor Jules Bordet, of Brussels, and Professor August Krogh, of Copenhagen, has been recorded in SCIENCE, but, following a press despatch, the subject of Professor Krogh's work was incorrectly given. He is professor of animal physiology at the University of Copenhagen and was a pioneer in the study of the forces governing gas exchange in the lungs and other parts of the body. Professor Bordet is now lecturing in this country on immunology and anaphylaxis. He has given the Herter lectures at the Johns Hopkins University, the Cutter lecture at Harvard University, a Hanna lecture at Western Reserve University and will give shortly a course of Hitchcock lectures at the University of California.

DR. THOMAS F. HUNT, dean of the college of agriculture of the University of California, Leon M. Estabrook, statistician and chief of the Bureau of Crop Estimates of the United States Department of Agriculture and Harvey J. Sconce, of Sidell, Ill., were appointed delegates from the United States to the general assembly of the International Institute of Agriculture at Rome, November 3–15. Dean Hunt, who has been appointed permanent delegate to succeed David Lubin, is in Europe on sabbatical leave from the university, and reached Rome in time to take part in the meeting.

DR. J. H. WHITE, assistant surgeon general and Surgeon G. N. Guiteras have been designated by Surgeon General Cumming to represent the United States at the sixth International Sanitary Conference to be held at Montevideo, Uruguay, on December 19 and 20.

SURGEON-GENERAL M. W. IRELAND, U. S. Army, has been appointed a member of the Council on Medical Education, of the American Medical Association to succeed the late Dr. Isador Dyer, of Tulane University.

THE appointment of T. W. Norcross as chief engineer of the Forest Service is announced by Colonel W. B. Greeley, head of the service. Mr. Norcross succeeds Mr. O. C. Merrill, who resigned to become executive secretary of the Federal Power Commission.

MR. F. R. COLE, of Stanford University, has been appointed associate curator in dipterology, and Mr. Chase Littlejohn, of Redwood City, California, assistant curator in ornithology, in the Museum of the California Academy of Sciences, San Francisco.

ACCORDING to the *Journal* of the Washington Academy of Sciences Mr. P. C. Holdt has been appointed research associate at the Bureau of Standards, by the American Paint and Varnish Manufacturers' Association, and Mr. E. J. Ruh by the International Nickel Company.

DR. NORAH E. DOWELL, instructor in geology at Smith College, has been appointed assistant geologist in the U. S. Geological Survey for duty as office geologist and research assistant in the Ground Water Division.

JOHN W. CALVIN, professor of chemistry at the University of Nebraska and associate chemist in the station, has become chemist in the experiment station of the Dominican Republic.

J. C. MCNUTT has resigned as head of the department of animal husbandry in the Massachusetts College to become eastern representative of the American Shorthorn Breeders' Association, with headquarters at Amherst.

DR. DOUGLAS R. SEMMES, professor of geology at the University of Alabama, has resigned his work at the university and accepted the position of assistant chief geologist of the Compañia Mexicana de Petroleo, "El Aguila," and will be located permanently at the company's headquarters in Tampico.

AFTER twenty-five years of active service in teaching and research work in applied chemis-

try and chemical engineering at the Massachusetts Institute of Technology, Dr. William H. Walker has tendered his resignation as director of the Division of Industrial Cooperation and Research to take effect on January 1. He will resume his consulting practise which was interrupted in 1917 by his entering the service, and, although no longer officially connected with the institute, will maintain his interest in the development of the division and will closely cooperate with it in the fulfilment of the contracts under the Technology Plan already existing. This division acts for the Institute of Technology in the administration of its obligation incurred under the Technology Plan by which over 200 of the most prominent industries of the country have made contracts involving annual retainer fees of over a quarter million dollars. He will be succeeded by Professor Charles L. Norton, professor of industrial physics at the institute and director of the Research Laboratory of Industrial Physics.

THE *Journal* of the American Medical Association quoting from the *Deutsche medizinische Wochenschrift* states that the Vienna physiologist, Professor E. Steinach, is intending to remove to Stockholm, where he will continue his research on physiology and biology.

THE *Journal* of the Washington Academy of Sciences reports the following foreign visitors to Washington: Dr. R. J. Tillyard, director of the Cawthron Institute of Scientific Research at Nelson, New Zealand; Dr. T. Harvey Johnston, of Queensland, who is on a mission to various parts of North and South America for the purpose of studying the cactus and means of controlling it, and Mr. A. K. Haagner, director of the zoological park at Pretoria, South Africa, who came to the United States in charge of a shipload of African animals which had been collected at Pretoria during the war for various American zoological parks.

DR. W. E. S. TURNER, secretary of the Society of Glass Technology, the University of Sheffield, England, and forty members of the society recently made a tour of the glass centers in America.

W. P. WOODING with a party from the United States Geological Survey have left for Haiti to conduct a reconnaissance geologic examination of the Republic of Haiti at the request of that government.

THE University of California has secured Mr. Bert A. Rudolph, a pathologist in the United States Department of Agriculture at Washington and a graduate of the State University, to develop further tests of control of apricot brown rot by spraying in the spring. The work will be carried on at the deciduous fruit station of the university and at Mountain View.

WINTHROP P. HAYNES, associate professor of geology at the University of Kansas, Lawrence, is on leave of absence for a year and is with the foreign production department of the Standard Oil Company of New Jersey. He will spend most of the winter with a geological surveying party in Mexico.

DR. A. C. TROWBRIDGE, professor of geology at the State University of Iowa, gave an address, November 3, as retiring president of the Iowa Chapter of the Society of Sigma Xi, "On the importance of sedimentation: a neglected phase of geological investigation."

DR. RAYMOND PEARL, of the Johns Hopkins University, on November 11, gave the Gross Lecture before the Philadelphia Pathological Society on "Some biological aspects of human mortality."

PROFESSOR ULRIC DAHLGREN, of Princeton University, delivered a lecture, on November 1, before the Franklin Institute of Philadelphia, on "The production of motion by animals."

DR. NELLIS B. FOSTER, of the Cornell Medical College, will deliver the third Harvey lecture at the New York Academy of Medicine, Saturday evening, November 20. His subject will be "Uræmia"

IT is announced in *Nature* that a course of three public lectures on "Present Tendencies of Philosophy in America," at King's College,

London, beginning on October 28 with a lecture on "New realism: its background and origin," was given by Professor W. P. Montague, professor of philosophy in Columbia University, New York City. The two other lectures were entitled: "New realism: its implication and promise," and on November 1, Professor J. E. Boodin, professor at Carleton College, Minn., gave a lecture on "Pragmatism: its right and left wings."

THE University of Bologna and the Royal Academy of Sciences held a joint commemoration service for the late Professor Righi on November 1, when an address was delivered by Professor Luigi Donati.

A GOLD medal, studded with diamonds, but valued chiefly because it had been "presented to Dr. S. D. Gross by his medical friends in commemoration of his fifty-first year in the profession, April 10, 1879," was recently given to Dr. J. Chalmers DaCosta, S. D. Gross professor of surgery at Jefferson Medical College, to be placed in the Jefferson College Museum.

PROFESSOR SAMUEL HANAWAY, who retired on account of health in 1916 from the department of mathematics in the College of the City of New York, has died at the age of 66.

M. H. P. STEENSBY, professor of geography at the University of Copenhagen, who was forty-five years old, died suddenly on board the liner *Frederik VIII.*, while returning from America, where he had been in connection with his investigations into the voyages of the old Norsemen to the coast of North America.

THE College of Physicians of Philadelphia announces that the next award of the Alvarenga Prize, amounting to about $250, will be made, July 14, 1921, provided that an essay deemed worthy of the prize shall have been offered.

PROFESSOR W. C. ALLEE, secretary-treasurer, of the American Society of Zoologists, writes that the committee on hotel accommodations for the Chicago meetings have assigned the American Society of Zoologists to the Congress Hotel, Michigan Blvd. and Congress St. The rates range from $3.00 to $9.00 for single rooms and from $7.00 up for double rooms. This hotel is the headquarters for the American Association and for the biological societies and members are accordingly urged to reserve rooms at their earliest convenience. Members of the zoologists desiring less expensive rooms may make reservations in the relatively nearby Y. M. C. A. Hotel at 822 S. Wabash Avenue before December 1. Rates: 70 cents, 80 cents and one dollar.

THE publication of *World Agriculture* as the official organ of the American E. F. Farmers' Club and the World Agricultural Society, is announced in the *Experiment Station Record*. It will be issued quarterly from Amherst, Mass. The purposes of the magazine are announced as follows: To further a sympathetic understanding among all nations in matters relating to the production, distribution and consumption of the products of the soil; to encourage study of the principles which should control the agricultural policies of the world to the end that every individual may do his full duty and may enjoy his rightful share of the results; to aid in the application of these principles through the dissemination of information, the exchange of students and teachers between educational institutions, and the rendering of practical assistance in the agricultural regions devastated by the world war and wherever such assistance is needed; to promote the correlation on world lines of all agencies concerned in rural improvement, technical, scientific, economic and social, and a greater appreciation of the possibilities of the country for the development of the highest types of individual and social life. In addition to the World Agriculture Society the journal expects to print official items regarding the International Institute of Agriculture, the American E. F. Farmers' Club, American Country Life Association, the International Live Stock Breeders' Association, the Beaune Committtee on World Cooperation in Agriculture and Country Life, the International Association of Agricultural Missions, the Agricultural Club of the North Carolina College, and the Agricultural Society of France. The June issue contains the officers of these organizations; reports of the Beaune conference of 1919, and

the Belgian national conference, and of the International Association of Agricultural Missions of 1920; a memorandum presented to the Peace Conference on World Agricultural Principles by President K. L. Butterfield, of the Massachusetts Agricultural College; a tribute to the late David Lubin; Some Impressions of French Agriculture by Captain E. N. Wentworth, assistant director of the college of agriculture, American E. F. University; the State Society of Agricultural Teaching in France, by G. Wery, director of the National Institute of Agronomy; several shorter articles relative to the reconstruction of French agriculture; and other topics.

UNIVERSITY AND EDUCATIONAL NEWS

Offers of support and financial assistance towards the establishment of an agricultural college of university rank in the West Indies have been received from Trinidad, Barbados, Grenada, St. Lucia, St. Vincent, and the Leeward Islands, while Bermuda, although not in the West Indies, has offered an annual grant. On the recommendation of the West Indian Agricultural College Committee, Lord Milner has decided that the promises and prospects of support are sufficient to justify him in proceeding with the necessary arrangements for the establishment of the college. It will be situated in Trinidad, and plans for the buildings will shortly be prepared.

Part of the $5,000,000 expected to be realized from a campaign for McGill University, Montreal, will be devoted to a building to house the departments of pathology, medical jurisprudence, hygiene and psychiatry. It is estimated that such a building would cost at least $460,000, and its maintenance would require an endowment of $150,000.

At the college of engineering of the University of Wisconsin, A. A. Neff, graduate of the University of Nebraska, has been appointed associate professor of machine designing, and A. H. Anderson, of the Armour Institute of Technology, Chicago, associate professor of steam and gas engineering.

Dr. B. J. Spence, professor of physics at the University of North Dakota, has resigned to accept a position in the department of physics of Northwestern University.

J. H. Gourley, professor of horticulture in the New Hampshire College, has become head of the horticultural department of the University of West Virginia.

DISCUSSION AND CORRESPONDENCE

AN UNFAVORABLE SPAWNING SEASON FOR MULLET

The mullet, *Mugil cephalus* Linnæus, known as *ama-ama* in the native language, is one of the most extensively used food fishes of the Hawaiian Islands. The custom of taking very young mullet from the sea and stocking ponds with them has been practised for a long time. These ponds, usually walled-off arms of bays, are frequently of several acres in area and from them are taken annually thousands of mullet which have developed to marketable size within these enclosures.

Although a well-known fish, aside from the fact that the fishermen have learned to know the approximate time of the year when the fry are abundant in the sea, no definite information is at hand relative to the spawning season of the mullet or the conditions favorable to this process or to its later growth and development in these waters.

With a view of undertaking artificial propagation of the mullet the Board of Fish and Game Commissioners of the Territory delegated Mr. H. L. Kelley, executive officer, assisted by Mr. Irwin H. Wilson, fish culturist, to establish a small fish hatchery at Kalahuipuaa, Hawaii, which was completed early in January of the present year. From observations during previous years it was believed that the mullet spawned during January. In the pond on which the hatchery was located it was estimated that there were approximately 1,000 mature females approaching the period of spawning and nearly as many mature males. Careful observations were kept upon the condition of the mullet throughout January and February but no indications of spawning were to be seen. Attempts were made to force the

roe and milt from the apparently ripe individuals. This was accomplished on two occasions but all efforts to fertilize the eggs thus obtained were futile.

Early in March the fish began to take on the appearance of being spawned out, but not having observed spawn or young fish in the pond up to this time, anatomical examinations were made of numerous mullet, both males and females being dissected.

In case of many of the females, the ovaries although greatly reduced were not spawned out but contained ova which evidently at one time were mature but now were in a state of semi-dissolution.

In case of the males, many of them carried gonads shriveled and reduced in size but having no appearance of organs after spawning. The surface of the testes, in many instances, were thickly covered with rounded nodules from 2–5 mm. in diameter. In sectioning portions of the organs thus affected masses of cells of a greenish-yellow tint, by transmitted light, were seen to occupy the nodules and penetrate deeply into the medullary substance of the gland. These masses, of definite outline, have the appearance of broken down tissue cells of the spermary but maintain their characteristic color under the action of such stains as iron hæmatoxylin and methylen blue. Healthy gonads free from the external nodules are also free from the internal masses of cells.

Inasmuch as a considerable number of individuals examined were affected in the manner described above we are led to believe that the noticeable scarcity of young mullet this season is a result of a pathogenic condition of the reproductive organs of mature individuals which inhibited spawning. The cause of this condition has not yet been determined.

Failure of the mullet to spawn in the usual prolific manner seems general throughout the Hawaiian Islands this season. The testimony of fishermen from widely separated districts is that there are comparatively few young mullet to be taken this year. One fisherman on Oahu reports that he has been able to take less than 2,000 fry for his ponds whereas in previous years he has taken as many as 900,000 from the same waters during a similar period. Another fisherman stated that he had taken about 6,000 as contrasted with 250,000 last year. A report from Kauai states that no mullet fry are observed in waters which in normal years are teeming with them.

From personal observations of those closely identified with the work of the Fish and Game Commission and from information received from reliable sources it would appear that the season just passed has been an unfavorable one for the spawning of mullet in these waters.

Further attempts will be made by the Board of Fish and Game Commissioners to carry on artificial propagation and culture of this important food fish.

C. H. EDMONDSON
UNIVERSITY OF HAWAII,

REMARK ON FAMILY NAMES

THE rules drawn up by Dr. Oberholzer[1] for the formation of family and subfamily names, seem to be very good in most respects, but in regard to that relating to family names founded upon almost identical names of genera, I must record my inability to concur. Under Rule 13, the author states that of two family or subfamily names having "exactly the same spelling," the latter is to be distinguished from the earlier by the prefix "*Pro*," and subsequently gives as an example the family names derived from *Pica* and *Picus*, proposing for one of them the name Propicidæ. According to all accepted rules for the formation of family names, this would indicate that there is a genus *Propica* or *Propicus*, which of course is untrue.

It would be much better in such a case as this to modify the generic root names in a slightly different way to form the family names, and that founded upon *Pica* might be Picidæ, using Picusidæ for that having *Picus* as the type. In forming the family name from that of the genus custom has differed in some instances; for example, in the Coleoptera, the generic word *Cis* has given rise to the family name Cioidæ in the case of some authors and

[1] SCIENCE, August 13.

Cisidæ with others. Personally, I would much prefer the latter as the permanent form for the word.

THOS. L. CASEY

RESEARCH PROBLEMS "ASSIGNED TO" UNIVERSITY PROFESSORS AND THEIR STUDENTS

A PAPER on North American Forest Research[1] has recently been issued, giving a résumé of the "Investigative Projects in Forestry and Allied Subjects Conducted by National, State and Provincial Governments, Schools of Forestry, Scientific Schools and Private Interests in Canada, Newfoundland and the United States for 1919–20."

More than five hundred projects are enumerated, nearly half of them under investigation by persons in departments of the United States government. Many of the remainder are concerned with the activities of various state agencies and institutions, while a number represent research undertaken by professors and their students in various colleges and universities.

The compilers of this list have very carefully indicated in connection with each project, by whom it is being investigated, nearly always stating that it is "assigned to" some individual or group of persons. For example, under certain universities and colleges, we find numerous projects "assigned to" various members of their faculties and in certain cases secondarily to their students.

I think we may legitimately inquire by whom these problems have been assigned to the persons named. Certainly not by the National Research Council, not by the Society of American Foresters, not by our colleagues, and usually not by any of the governing boards of the universities and colleges.

Such wording, like the repeated use of "control" and "direction," conveys the imputation that men of science do not select and elaborate their own lines of research, and it is very unfortunate that it should appear in such a journal as the *Bulletin* of the National Research Council. Let us hope that the council does not stand sponsor for it, for it does not seem likely that it will aid in attaining the closer cooperation which independent workers hope to see as a result of the operations of the Research Council. It is better to believe that the printer or the proofreader has inserted this stereotyped phrase as it appears quite regularly, and no doubt properly so, in connection with many of the bureaus and governmental agencies. In view of the increasing extension of the bureaucratic spirit into scientific work, perhaps all research must be assigned by some one other than he who performs it, and possibly problems should not be outlined by those who investigate them. Until such comes to pass, however, it seems unjustifiable that research in forestry or in any other subject should be thrust into the lime-light with such carelessly worded captions attached.

C. T. BRUES

[1] Compiled by the Committee on American Forest Research, Society of American Foresters, and published as Vol. 1, Pt. 4, of the *Bulletin* of the National Research Council, August, 1920.

THE LAWS OF HYBRIDIZING DISCOVERED BY RICHARD DIENER

THE above is the title of a booklet of some sixteen pages, dated (with a rubber stamp) as issued July 1, 1920, and coming, appropriately, from California, the home of plant wizardry. The discoverer states that it has taken thousands of crosses and fifteen years of time to perfect the laws which he is now giving to mankind—for a consideration. Their presentation is a delightful example of simplicity; the reader is not troubled with tiresome descriptions of methods or measures taken to check the results; the pages are not rendered unsightly by arrays of tables, nor is the intellect taxed by incomprehensible statistics, as is so often the case in present-day treatises on this subject. On the contrary the author has not needed all of his sixteen pages for the exposition; besides the title page he is able to spare one for a full-page portrait of himself, five pages are given to photographs of results of his labors, while a double-page diagram sets forth his laws so clearly that

one feels the text might really have been dispensed with entirely.

Nevertheless there are six and one half pages of text, three of which, however, are occupied by a philosophical discussion of "What plant life is," the nature of "Sports," and "Animal life in relation to plant life." The relation of these introductory remarks to the laws that follow is not clear; they nevertheless contain contributions to the subject of evolution which are novel, and their inclusion was presumably considered justified on their own merits. We learn first that plant life is a chemical process for catching the sun's rays and depositing them on the earth in the form of carbon. As with mortal souls, however, the abode of carbon on the earth is but transitory; "some day fire is set to it," whereupon it disappears from the earth as gas and only ashes remain.

Early plants floated in moisture in a sexless state, but they finally succeed in getting roots into the soil, climbed out of the marshes and developed sex, and so rose to the stage of seed production. Until they got their toes into *terra firma* evolution was slow, but that advantage once gained they "developed faster—from grasses to shrubs, from shrubs to bushes and from bushes to trees!" Animals also play an important rôle in the cosmos, for we are told:

> If it were not for the existence of animal life the leaves, bark and general residue of vegetation would, in a period of twenty-five years or thereabouts, cover the ground to such a height that no new vegetation could spring up and plant life would annihilate itself, there being no decay.

About three and one half pages are left for the "laws," which are illustrated by diagrams relating to relative size of flower or fruit or other character of the plants to be crossed. There are three possibilities: (1) The male (pollen) parent may be smaller than the female (ovule) parent, (2) they may be of the same size, or (3) the male parent may be the larger of the two. The first is the "declining way" of breeding, for the offspring from such crosses will be smaller even than the male parent. The second is the "enlarging way," for when the parents are of the same size the offspring will be twice as large as their parents. Not all of them will reach this maximum size, we learn to our disappointment, but on the average only 12 in 100. This may be brought up to 40 per cent., nevertheless, in later generations. Finally, the third way is less important, for under these conditions the offspring are said to exceed the male parent only slightly in size.

Fortunately the benefits of these laws are not limited to plants but may be applied in animal breeding as well, as "exemplified by chickens." Here the process is admittedly complicated by the fact of "the sexes being in different individuals," necessitating a backcross of the progeny with their male parent, but the result is well worth the extra trouble, for "of the offspring from this second fertilization about one third are double the size of the original parents." This may be a desirable economic result so far, but one shudders to think what may happen if the method should be taken up by unthinking persons and pushed to the limits of geometric progression. The author truly says that "few people at the present time realize the immensity of this discovery to mankind." He himself modestly admits that it is "equal to the discovery of electricity, if not greater." And any one may take advantage of it by purchasing the booklet for the sum of five dollars—as indicated by another rubber stamp.

A book of this character would scarcely be deserving of so much attention if it were not for the fact that it is likely to be taken seriously by a great many people. There is just enough of fact in some of the statements to make the conclusions seem plausible to one not familiar with genetic interpretations. For example, it is stated that in attempting to derive new colors, a white flower should be used as the pollen parent. Every geneticist knows that white flowers may carry a great variety of genes for color which can find expression only when a cross is made which brings in an activator for them. Similarly, some of the facts stated in relation to size inheritance may be true in the instances

cited; the mistake is the one practical breeders have so commonly made for generations past of generalizing from a few instances. One often wishes it were as easy to inculcate into students the principles of genetics as it is to gain a wide acceptance of theories that have no scientific basis and calmly disregard any demands for proof.

L. J. C.

SPECIAL ARTICLES

ON THE RELATIONSHIP BETWEEN FREEZING POINT LOWERING, Δ, AND SPECIFIC ELECTRICAL CONDUCTIVITY, K, OF PLANT TISSUE FLUIDS

THE problem of the contribution of non-electrolytes, of undissociated molecules of electrolytes, and of dissociated ions of electrolytes to the depression of the freezing point, Δ, in terms of which osmotic concentration is usually measured, is one of considerable biological importance. We desire to know, for example, whether an observed difference in the osmotic concentration of the tissue fluids of a species growing in two different habitats is due primarily to differences in the quantities of electrolytes absorbed from the medium or to differences in the quantities of organic substances elaborated. The same question naturally arises when one is comparing the osmotic concentration of the tissue fluids of different species in the same habitat.

In the mixed solutions with which the biologist has to deal the problem presents serious difficulties. In certain cases some progress may be made by determining the correlation between the freezing point depression, Δ, and the specific electrical conductivity, K.

As a specific illustration we may take the relationship between osmotic concentration and electrical conductivity in a series of plant species growing in the non-halophytic habitats of the north shore of Long Island.[1]

In a series of 19 species of trees, 36 species of shrubs, and 162 species of herbs both Δ and K are highly variable. The coefficients of variation, *i.e.*, 100 σ/m, where σ is the standard deviation and m the means are:

	Δ	K
Trees	21.46	28.49
Shrubs	18.46	28.03
Trees and shrubs ...	20.20	28.27
Herbs	23.46	25.33

Our problem is to determine whether higher values of K are associated with higher values of Δ, or whether within each of these growth forms[2] these two constants of the solution are essentially independent.

Determining the correlation coefficients by the usual product moment method we have the following measures of relationship between the magnitudes of K and Δ in the various series.

For trees, $N = 19$, $r = +0.127 \pm .152$
For shrubs, $N = 36$, $r = -0.079 \pm .112$
For trees and shrubs, $N = 55$, $r = +0.022 \pm .091$
For herbs, $N = 162$, $r = +0.150 \pm .052$

For ligneous plants the correlations between Δ and K are low and statistically insignificant in comparison with their probable errors. The coefficient for shrubs is actually negative in sign. That for trees and shrubs together is sensibly zero. The coefficient for herbaceous plants is also low but may indicate a slight relationship between the two constants, higher values of Δ being associated with higher values of K and *vice versa*.

These results show that, in the vegetation of the glacial moraines of Long Island at least, there is practically no relationship between the concentration of ionized electro-

[1] Protocols of data and full details are given in a paper in press in the *Journal of Physical Chemistry*.

[2] It is necessary to separate the growth forms, since, as shown in detail elsewhere (Harris, Gortner and Lawrence, *loc. cit.*), the growth forms are highly differentiated with respect to both Δ and K. The actual means are:

	Δ	$K \times 10^6$
Trees	1.292	11,213
Shrubs	1.177	10,770
Trees and shrubs ..	1.217	10,923
Herbs	0.846	14,308

lytes and of total solutes (molecules and ions) in the leaf tissue fluids.[8]

J. ARTHUR HARRIS,
ROSS AIKEN GORTNER,
JOHN V. LAWRENCE

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

MINUTES OF THE EXECUTIVE COMMITTEE OF THE COUNCIL

THE meeting was called to order at the Hotel Belmont, New York City, on October 17, at 11 A.M., with Dr. Simon Flexner in the chair. The following members were present: Cattell, Fairchild, Flexner, Humphreys, Livingston, Nichols, Osborn.

1. *Minutes of last meeting* (published in SCIENCE, May 7, 1920) were approved.

2. *Audited report of retiring permanent Secretary* (Dr. L. O. Howard, for period from November 1, 1919, to April 1, 1920, was accepted and ordered to be filed and published in SCIENCE.

3. *Summarized report of new permanent secretary* (Dr. Burton E. Livingston) for period from April 1 to September 30, 1920, was accepted and it was ordered that such parts of it be published in SCIENCE as seem desirable to the permanent secretary. (The financial statement will be presented to the council before publication; other features will shortly appear in SCIENCE.)

4. *Election of section officers.*—Dr. A. E. Jenks was elected to be vice-president and chairman of Section H (Anthropology). Dr. E. A. Hooton was elected secretary of Section H.

5. *A special committee on the organization of Section H (Anthropology)*, which is a new section, formed by the division of the old Section of Anthropology and Psychology, was established, this committee to be appointed by the president and permanent secretary in collaboration and to cooperate with the section officers just elected. (This committee will shortly be announced in SCIENCE.)

6. *Present permanent secretary* was nominated to the council, to continue to serve during the ensuing 4-year term as heretofore; that is for one third of his time.

7. *Other nominations for Association officers* (president, general secretary, treasurer, five council members, two executive committee members). It was voted that these nominations be made at the first meeting of the council at Chicago and that elections occur at a later meeting of the council.

8. *Nominations for Committee on Grants* (3 members), to be appointed by the president with advice of the council. The executive committee recommends to the council that it is desirable to nominate members who are not now members of the Grants Committee, but the various branches of science should continue to be severally represented as heretofore. This matter should receive attention at first Chicago meeting of Council and nominations should be made at second meeting.

9. *Science News Service*, supported by Mr. W. E. Scripps. Dr. J. McK. Cattell and Dr. Geo. T. Moore were elected to represent the association in an advisory committee of this service.

10. *Editorial Committee for Science.*—It was voted that this committee continue to be constituted as heretofore; namely, of (*a*) its original members, (*b*) the chairman of the association sections for each year, and (*c*) the members of the executive committee.

11. *Determination of the chairman of Executive Committee.*—It was voted that chairman of this committee is to be elected by the committee at its last session at each 4-year meeting of the association, the term of office of the chairman to be for no more than four years.

12. *Election of Fellows.*—Three hundred and seven members were elected to fellowship, their nominations having been received from the following sources: by Secretary of Section A, 6; by Secretary of Section B, 37; by Secretary of Section E, 35; by Secretary of Section G, 162; by Secretary of Section O, 5; by Secretary of Section Q, 56; by permanent secretary, 6. It was voted that nominations for fellowship received by the permanent secretary shall hereafter be referred to the secretary of the proper section, so that all nominations shall come to the executive committee from the section secretaries. (Nominations for fellowship should be sent to section secretaries rather than to permanent secretary. Section secretaries are urged to send their lists of nominations to the permanent secretary in time so that they may be acted on at each meeting of the executive committee.)

13. *Auditor* for permanent secretary's annual report. The resignation of Mr. Herbert A. Gill was accepted and filed, and the committee passed

[8] This result holds within the individual classes. In comparing ligneous and herbaceous growth forms we note that the growth form with the higher total concentration has the lower conductivity. This is shown by the fact that the ratio of $K \times 10^6$ to Δ is 10923/1.217 for trees and shrubs but 14308/0.846 for herbs.

a unanimous vote of thanks to Mr. Gill for his valuable and much appreciated services as auditor. The appointment of an auditor for this year was referred to the president and permanent secretary, with power.

14. *Organization of Committee on Grants.*—It was voted that Committee on Grants shall elect its chairman and secretary.

15. *Place of 1922–23 annual meeting.*—This was discussed, and Boston was tentatively recommended. (The 1921–22 annual meeting is to be held at Toronto.)

16. *Expenses of section secretaries attending annual meetings.*—It was voted to recommend to the council that Art. X., Sect. 2, of the by-laws be so amended as to authorize the permanent secretary to pay section secretaries who attend annual meetings a refund amounting to four cents per mile for the round trip in each case.

17. *Expenses of section secretaries attending the Chicago meeting.*—The permanent secretary was authorized to refund to each section secretary attending the Chicago meeting a sum amounting to four cents per mile for his round trip.

18. *Expenses of executive committee members* attending spring and fall committee meetings. It was voted to recommend to the council to take under consideration the amendment of Art. X., Sect. 3, of the by-laws so as to authorize the permanent secretary to pay executive committee members attending spring or fall meeting of this committee a refund amounting to four cents per mile for the round trip in each case.

19. *Sonora and Chihuahua.*—It was voted to recommend to the council that Art. VI., Sect. 1, of the by-laws be so amended as to remove the Mexican states of Sonora and Chihuahua from the province of the Pacific Division and to place them in that of the Southwestern Division.

20. *Benjamin collection of portraits and autographs of association presidents.*—It was voted to recommend to the council that it authorize the permanent secretary to purchase for the association the Benjamin collection of portraits and autographs of the presidents of the association (74 portraits, each with autograph letter), at a price of $300.

21. *Proposal to inaugurate a section on History of Science.*—This action has been recommended by a large number of members. The proposal was thoroughly discussed but the committee did not feel justified in recommending it, since the proposed section would not be coordinate with the sections already established. It was suggested that this very desirable aspect of scientific advancement (which is thoroughly approved by the committee) be organized in the new section L (Historical and Philological Sciences), to which it appears logically to pertain.

22. *Committee vote by mail.*—It was voted that Professor Pickering's method for voting by mail be generally used by the permanent secretary when such voting of this committee is requisite.

23. *The Gamma Alpha Graduate Scientific Fraternity* was made an affiliated society by vote of this committee. (It will have two representatives in the association council.)

24. *Affiliation of state academies.*—It was voted to extend the special offer on this subject through 1921. Academies becoming affiliated before October 1, 1921, are to receive from the permanent secretary a payment amounting to one dollar for each academy member who has paid his annual dues ($5) to the association for the year 1921.

25. *Stationery for use of section secretaries.*—Proposal that permanent secretary's office furnish uniform stationery to all section secretaries was referred to permanent secretary, with power.

26. *Sectional committee personnel.*—It was voted that when an affiliated society embraces more than a single section of the association, its representatives in the association council shall not be members of any sectional committee.

27. *Railway rates for annual meetings.*—It was voted that the permanent secretary be instructed to investigate the basis on which reduced railway rates are sometimes granted to societies, with the aim of obtaining these rates for annual meetings of the association in the future. (Reduced rates for the Chicago meeting have been denied.)

The committee adjourned at 4.

BURTON E. LIVINGSTON,
Permanent Secretary

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, NOVEMBER 26, 1920

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

HARMON NORTHRUP MORSE

AFTER a long life spent in service in Johns Hopkins University Professor Morse died September 8, in the seventy-second year of his age. He was born October 15, 1848, at Cambridge, Vermont, the son of a farmer, and died at Chebeague, Maine, where he had spent his summers for many years. He was graduated from Amherst College in 1873, then went to Göttingen, and received the degree of Ph.D. from that university in 1875. The year 1875–76 was spent at Amherst as assistant in chemistry. In 1875 it was announced that the Johns Hopkins University would begin its work in the year 1876. Shortly after it became known that the writer of this notice was to be the professor of chemistry in the new university he received a call from Morse who brought a letter of introduction from Emerson. This letter led me to take more than ordinary interest in the bearer. Whatever we were to do in Baltimore, it seemed clear that I should need an assistant, and I told him I would in due time arrange for his appointment. Hearing a little later of the fellowships that were to be awarded I secured one of these for Morse and so his connection with the Johns Hopkins University began. Before the doors were opened, however, he was designated associate, and we began our work together for better or for worse. We had no laboratory. We had less than a handful of students. What was to come of it? I need not go into the story, thus suggested except to say that we were absolutely untrammeled and left to work out our own salvation. Morse and I were of one mind as to the object to be attained and there were no discussions in regard to the methods to be adopted. They were not original, but they had never been tried in this country. There had never been an opportunity. The opportunity that many of us had hoped for, had dreamed of, was furnished by the bounty

of Johns Hopkins and the wisdom of his trustees and of President Gilman.

Morse remained an associate until 1883, when he became an associate professor. In 1892 he was promoted to be professor of inorganic and analytical chemistry, and in 1908 he became director of the chemical laboratory. In 1916 he withdrew from active service and became professor emeritus.

From the beginning of our work in the new university the importance of research was emphasized. That was indeed its most characteristic feature. Morse was as anxious as any of us to take part in this work. For one reason and another it was some time before he got going. To be sure he did show his hand in some small and rather unpromising pieces of work and I think he became discouraged, but he was faithful to his teaching. Gradually, however, his researches opened up new fields and he began their exploration. This is not the place for a full review of his contributions, and those of his last years so overshadowed all that preceded that a reference to those alone will do substantial justice to his memory.

In the early nineties he turned his attention seriously to the question of the stability of solutions of potassium permanganate and in 1896 he published an article on "The production of permanganic acid by manganese superoxide," A. J. Hopkins and M. S. Walker appearing as joint authors. Pursuing this subject Morse and H. G. Byers in 1900 published an article "On the cause of the evolution of oxygen when oxidisable gases are absorbed by permanganic acid." The results were such that it became desirable to obtain an aqueous solution of pure permanganic acid. It was decided to prepare this by dissolving the heptoxide in water. In an article by Morse and J. C. Olsen that appeared in 1900 occurs the following passage:

> (We) accordingly prepared a quantity of the anhydride by mixing potassium permanganate and concentrated sulphuric acid in vessels cooled by ice and salt. We soon learned, however, that something more than a low temperature is essential to safety in handling the product; for a minute quantity of the anhydride—certainly less than half a drop—which had been separated from the sulphuric acid, exploded with great violence and with disastrous results to one of us.[1] Some idea of the force of the explosion may be gained from the fact that one of the flying fragments of glass passed entirely through a burette which was mounted in the vicinity, leaving holes over half the diameter of the burette, edges of which were entirely free from cracks. After this experience, we decided to abandon the anhydride as a source of the acid, and to work out, if practicable, an electrolytic method of separating it from its salts.

The electrolytic method worked very satisfactorily, and led to the further use of this method in the preparation of osmotic membranes. The first results of this investigation are given in an article by Morse and D. W. Horn that appeared in 1901. They say:

> In this connection, it occurred to the authors that if a solution of a copper salt and one of potassium ferrocyanide are separated by a porous wall which is filled with water, and a current is passed from an electrode in the former to another in the latter solution the copper and the ferrocyanogen ions must meet in the interior of the wall and separate as copper ferrocyanide at all points of meeting, so that in the end there should be built up a continuous membrane well supported on either side by the material of the wall. The results of our experiments in this direction appear to have justified the expectation and to be worthy of a brief preliminary notice.

This marks the real beginning of the work on osmotic pressure with which the name of Morse will always be associated. But before the cells were available and therefore before any reliable measurements could be made, years of patient, skilfull work were still necessary. Difficulties that seemed insurmountable frequently arose and necessitated new efforts. It must be said that some of us in the laboratory, including myself, at times

[1] To make this story complete it should be added that Morse was the "one of us" here referred to. A piece of glass passed through the tissues of his neck in close proximity to the jugular vein. His escape from death was almost miraculous.

lost faith in the ultimate success of the work and were perhaps inclined to advise the use of cells that were not perfect. But Morse went steadily on. He had in mind a practically perfect cell that could be used for high pressures as well as low. He tried all sorts and conditions of clay and after many, many discouragements he succeeded in finding one and in making a satisfactory glaze quite different from any available, and he achieved success.

In 1902 he and J. C. W. Frazer described "The preparation of cells for the measurement of high osmotic pressures." A careful reading of this article will give some idea of the tremendous difficulties that were met and overcome. The closing paragraph may be advantageously quoted in this connection:

> The difficulties of construction are by no means completely overcome, and we have in view a number of changes which we hope will provė of advantage. That these difficulties are of great magnitude will be realized if one considers that in our last experiment the pressure which was measured and which was still below what we were called upon to control would suffice to raise a column of water at 20° to a point 15 meters higher than the top of the Eiffel tower, or which would raise from its base a marble shaft whose height is 120 meters. These comparisons will perhaps make it clear that the most painstaking attention to every detail of construction is absolutely essential to success when an apparatus like ours is to be made up of several parts, consisting of different materials, and which must be united without the usual mechanical means means of securing strong joints.

Soon after this the Carnegie Institution of Washington lent its powerful aid to the large investigation thus begun. In 1914 the institution published a memoir entitled "The Osmotic Pressure of Aqueous Solutions: Report on Investigations made in the Chemical Laboratory of the Johns Hopkins University during the years 1899–1913. By H. N. Morse." In it is given a detailed account of this remarkable piece of experimental work. Any one who reads it understandingly will recognize that no one but a master of experiment could have done this. The work required the highest degree of resourcefullness and skill, of patience and persistence. Any one of ordinary caliber would have stopped short of the accomplishment. Morse was not satisfied with anything but perfection as nearly as this could be reached, and as it never can be reached he worried about the residual no matter how small it might be. In the concluding chapter of the Carnegie Memoir occur these words:

> The work reported upon in the preceding chapters is only a fraction of the task which the author hopes to accomplish, or to see accomplished by others. The investigation—already fifteen years old—was undertaken, in the first instance, with a view to developing a practicable and fairly precise method for the direct measurement of the osmotic pressure of aqueous solutions. The need of such a method for the investigation of solutions seemed to the author very great and very urgent.

Honors came to him rather late but they came, the chief among these was the award of the Avogadro Medal of the Turin Academy of Sciences, in 1916.

> In 1911 an international congress of scientists assembled at Turin, Italy, to celebrate the centennial of the announcement of the hypothesis of Avogadro. Those in attendance decided to award a medal to be known as the Avogadro Medal. This medal was to be awarded to the investigator who should, in the judgment of the awarding committee, make the most valuable contribution to the subject of molecular physics during the years 1912, 1913 and 1914.

A few words in regard to Morse, the man. He was quiet and uneffusive. He did not care for the ordinary intercourse with his fellowmen. He lived, when not in the laboratory, for his family and a few kindred spirits. He married twice and had four children—a daughter and three sons. His second wife, who was Miss Elizabeth Dennis Clark, of Portland, Maine, his daughter and two sons survive him. In his later years his wife was of great assistance to him in preparing his articles for publication and was a true helpmate in every way.

For many years he spent his summers at Chebeague in the beautiful Casco Bay. Here

he had a simple comfortable cottage and a garden. He delighted to work, both in and out of the house, and this gave him his exercise. He was rather stout and he knew that he needed exercise to keep his weight down. He therefore indulged in walking, bicycling and finally in motoring, and he managed to keep fairly well. But, after his retirement in 1916, his health failed. His strength gave out and his courage also. He did not dare to take his car out of the garage, and his walks were very short. I saw him in May, just before he went to Maine, and thought he seemed more like his old self. He even talked of taking up his work again. It was not to be. I heard nothing from him after that. And then came the despatch announcing his rather sudden and entirely unexpected death. He was buried at Amherst, a place that meant so much to him—where he had spent his college years and for some time had had a summer home.

Ira Remsen

WILHELM WUNDT, 1832–1920

The death of Wundt removes the foremost figure of our academic world: a great man of science, a philosopher of repute, a prolific writer, a personality of extraordinary influence. Psychology, the science with which his name is permanently connected, was fortunate both in the date of his birth and in the length of his life. He came into the world a full decade later than Helmholtz and Virchow and Du Bois and Leuckart, Huxley and Tyndall and Spencer, the standard-bearers of science in the middle of the nineteenth century; so that, while his work and theirs overlapped, he still reaped the benefit of their pioneer labors. His length of days and the maintenance of his intellectual vigor not only enabled him to round off his manifold tasks—we all rejoice that the "Völkerpsychologie" is done, as we all rejoiced when Spencer published the final part of his "Synthetic Philosophy"—but also gave a much-needed stability to the young science of experimental psychology, whose name he coined and whose interest lay always nearest to his heart.

Wundt's outward life was uneventful. After a half-dozen years of study, principally in medicine, at the universities of Tübingen, Heidelberg and Berlin, he settled down as docent (1857) and assistant professor (1864) of physiology at Heidelberg, where Helmholtz held the chair of physiology from 1858 to 1871. In 1874 he was called as professor of philosophy to Zurich, and in 1875 was chosen in preference to Horwicz (who nowadays reads the once famous *Analysen?*) as professor of philosophy at Leipzig. Here he remained till the end of his life, gathering in his harvest of academic honors: the rectorship of his university, the honorary citizenship of the town, the order *pour la mérite*, the title of *wirklicher Geheimrat* of the kingdom of Saxony. He lived the simple family life of the older German tradition, and his days passed with the regularity of clockwork: the morning he spent on his current book or paper; then came the *Sprechstunde;* then, after the midday meal, his solitary constitutional in the park; then the formal visit to the laboratory; then the lecture; and then an informal gathering in the laboratory again. Wundt was an effective lecturer, and made no use of notes, though he always carried in his pocket a scrap of paper upon which notes had been made. He was devotedly cared for by his wife and, after her death, by his daughter, "meiner treuen Gefährtin im Urwald der Mythen und Märchen." His son turned some years since from philology to philosophy, and has written a valuable work upon Greek ethics.

Under these outward conditions, simple and sheltered, Wundt carried on his varied literary activities. If I were asked to pick out the most original and constructive items of his published work, I should name in the first place his "Beiträge zur Theorie der Sinneswahrnehmung" (1862), a rounded series of researches upon tactual and visual perception which contains in germ the doctrine of the later and better known *Physiologische Psychologie.* I should name, secondly, the *Untersuchungen zur Mechanik der Nerven und Nervencentren* (1871–1876), a solid bit of

experimental investigation, quoted with respect by later physiologists. I should name, thirdly, the second part (Methodenlehre) of the "Logik" (1883 and later), which carries on the work of Mill and Jevons, but far outranks its predecessors in depth of insight and range of positive knowledge. I should name, fourthly, the highly characteristic "Psychologismus und Logizismus" of 1910; Wundt was at his best, constructively and historically, when he had been spurred into action by the success of what he thought a scientific heresy And I should name, last, the little "Einführung in die Psychologie" (1911), a book in which Wundt's consummate mastery of his subject and the sweep and freedom of his style bring him as near as he ever came to the popular conception of a genius.

I have not included in this list the "Grundzüge der physiologischen Psychologie." Every one knows that Wundt founded, in 1879, the first laboratory of experimental psychology; and every one knows that the *PP,* as his students have dubbed it, is the standard work of reference for that science. The book was, no doubt, born of a great idea; and it is, without question, indispensable to the psychologist. But I do not think that it is a great book; that, in the very nature of the case, it could hardly be. Its one serious rival, Brentano's "Psychologie vom empirischen Standpuncte," which saw the light in the same year (1874), is great both in conception and so far as it goes—it goes only half-way to its appointed goal—in execution; as late as 1907 Brentano had published only two minor corrections of his original text. But Wundt was attempting an impossible task, the welding of a highly imperfect nerve-physiology to a rudimentary experimental psychology. He approached it with full scientific equipment and with no small measure of literary skill; the result, none the less, was inevitably an encyclopedic handbook of the two disciplines rather than a single physiological psychology. So it comes about that Brentano's "Empirical Psychology" stands to-day as it stood nearly fifty years ago, while the *PP* has lumbered through edition after edition, hardly even aiming at system before the fifth (1902–3), and still badly needing system in the sixth and last (1908–11). The demand for these editions proves that the book is, as I said just now, indispensable to the working psychologist, and we can not be too grateful to Wundt for the time and labor spent upon the successive revisions. It would be a pity, however, if he were to be judged by a work which, characteristically thorough and painstaking as it is, still represents only one side, and that perhaps the least original, of his efforts on behalf of experimental psychology. The Wundt who organized the Leipzig laboratory, and who wrote or directed the investigations that fill the twenty volumes of the "Philosophische" and the ten of the "Psychologische Studien," is larger than the Wundt of the familiar book.

The long series of editions proves, of course, that the *PP* has appealed to a far wider circle than that of the professional psychologists. Wundt, indeed, has always been singularly successful with his literary ventures. We expect that a class-text, if it survives the first crucial year, will be often reprinted; but we do not expect that three-volume works on ethics and logic, to say nothing of a "System der Philosophie" which expresses its author's personal convictions in highly abstract terms, will again and yet again demand revision and reissue during their writer's lifetime. Such, nevertheless, has been Wundt's fortune. Most astonishing of all is the career of a semi-popular book, translated into English under the title "Lectures on Human and Animal Psychology": first published in two volumes in 1863, it achieved its sixth edition, as a single volume, in 1919. Not that there is any real reduction in size!—that has not been Wundt's habit. On the contrary: the lectures of the original edition that dealt with social psychology have simply been excluded, and their modern equivalent published separately, in the ten large volumes of the "Völkerpsychologie."

So we are brought to this tremendous achievement of Wundt's old age. He published the first two volumes, on Language, in

1900, when he was already nearly seventy; he published the concluding volume, on Civilization and History, in 1920. The intervening volumes deal in turn with Art, Myth and Religion, Society and Law. The whole undertaking grew out of Wundt's early conviction that psychological experiment breaks down on the far side of perception and memory, so that the processes of thought and of constructive imagination must be studied by other than experimental means. Hence a "Völkerpsychologie" is, for him, the direct continuation and supplement of experimental psychology. We may dispute his standpoint: we may question whether experiment fails where he makes it fail, and we may question further whether his own social psychology is not rather an application of his individual psychology to the data of social anthropology than the path to a discovery of new psychological principles. We may doubt also whether the time is ripe for generalization, whether there is not more to be gained by intensive labor. But no one who reads the book can fail to pay his tribute of admiration to its unfailing vitality, to its masterful ordering of detail, to its theoretical consistency. The "Kultur und Geschichte" ends on a somewhat forced note of optimism, beneath which there sounds—as how should there not?—a steady undertone of strained perplexity. Yet it is only here and there that the attentive reader discerns a momentary lapse either of style or of logic; the intellectual freshness is maintained to the end.

The significance of Wundt's whole work, if one tries to sum it up in a sentence, lies in the fact that he is the first considerable figure in the history of thought to attack the problems of science and philosophy from the psychological standpoint. Wundt was a born psychologist; and if others before him had a similar temperament, they had not the same opportunity. Wundt himself struggled into psychology, and never shook himself entirely free either of past philosophical systems or of the all-too-logical biology of the first Darwinian time. But he grew with the years: the last edition of the "Physiologische Psychologie" is better psychology than the first. He has often been compared with Herbert Spencer; he himself would prefer to be considered a modern follower of Leibniz. Neither comparison satisfies. Wundt was unique, and we shall not look upon his like again.

Edward Bradford Titchener
Cornell University

ON THE DETERMINATION OF GEOCHRONOLOGY BY A STUDY OF LAMINATED DEPOSITS

In Science of September 24, 1920, a highly esteemed geologist[1] has honored the Swedish expedition now studying some of the laminated clay deposits of North America with a discussion of its aims and work which seems to call for some reply.

The main purpose of our expedition may be stated as being less the hope of making new discoveries than a first attempt to apply to the late Quaternary deposits in North America the theories that have been developed in Sweden by many years of extensive investigations. There by systematic measurements of certain periodically laminated layers of late Quaternary age we have succeeded in establishing a real, continuous and exact time scale and not merely determinations applicable to isolated localities. Of course many and serious difficulties have been met, and it has taken much time—more than forty years—to overcome them all. The latest and most important progress was my discovery, five years ago, that the variation in thickness of annual layers deposited at different places along the same ice border could be identified, even at the greatest distances from which measurements were obtained, local errors being absent. This indicated a common, general climatic cause. If it can be shown that similar annual variations occur on both sides of the Atlantic, as far as the extension of one and the same climatic zone [can be assumed], it means that the cause must be sought in

[1] Fairchild, H. L., "Pleistocene clays as a chronometer," Science, N. S., Vol. 52, p. 284, 1920.

variation in the amount of heat radiating from the sun.

The premises advanced have not hitherto given rise to any other conclusion as to the cause of the Ice Age than that a solution of the problem, in its general nature, can be reached in this way.

With respect to the method of overcoming the difficulties of the new branch of investigation the brief memorandum which I issued, which was intended mainly for specialists, could only refer to a somewhat more comprehensive statement of mine,[2] which also gave a short historical review from 1878. From this review it may be learned that after publishing in 1884 my first plan of obtaining a geochronology, but before trying earnestly to follow it out, I was so impressed with the supposed difficulties of the task that it was not until 1904, or twenty years later, that I took the matter up seriously. Thus I am indeed well aware that it is not enough to be cautious, one must also be audacious.

Having thus myself delayed for twenty years, it was just with a thought of the daring energy of my esteemed American friends that I gave myself the hope of trying by something like a spurt to regain some portion of the time which had been lost. As may be known by all who have followed this question, the investigations thus begun have been unexpectedly successful in results.

On the present occasion I have appealed to the kind collaboration of my American friends for organizing with their aid the application on their continent of a method of investigation which already has been tested in a region, the nature of which from several points of view has a striking similarity with that of the formerly glaciated regions of North America. Yet, the glaciation of this latter continent was much more extended than that of northern Europe. Certain parts of its highly interesting glacial geology, according to the admirable investigations of the American geologists, showing a very complicated late glacial evolution, it seems highly probable that the introduction and use of a real time scale here will be of special interest and that comparisons with the conditions in Sweden and other parts of northern Europe will doubtless be very instructive in many respects.

In the hope of a continued, fruitful collaboration I use this occasion to express my hearty thanks for the great hospitality and all the kind interest, which from so many sides, in the United States as well as in Canada, have been shown to the expedition, and especially so from the American Scandinavian Foundation, which never fails to support every initiative aiming at the evolution of our mutual relationships.

De Geer

[2] Gerard de Geer, "A geochronology of the last 12,000 years." Presidential address, Eleventh International Geological Congress, Stockholm, 1910—Map and diagrams. Comptes Rendus, 1912.

SCIENTIFIC EVENTS

DEDICATION OF THE NEW LABORATORY BUILDING OF THE BUREAU OF FISHERIES AT FAIRPORT, IOWA

At the United States Fisheries Biological Station at Fairport, Iowa, the new laboratory building has been publicly dedicated in the presence of a large assemblage composed of representatives of various state universities, the pearl-button industry and the Bureau of Fisheries, together with the Assistant Secretary of Commerce and the member of congress from the Fairport district.

The new laboratory, which is constructed of concrete, stone and brick, replaces a frame building destroyed by fire in 1917. The building is about 100 by 50 feet, with three stories and half basement; and is superior to the old structure in respect of serviceability, convenience and capacity. The laboratory accommodations for 16 investigators may be increased as circumstances require. A well-lighted library, a chemical laboratory, a photographic room, a museum, a mess hall and kitchen, and tank and aquarium rooms in addition to offices are among the useful features of the building.

The dedication exercises were as follows:

Remarks by the chairman, Hon. Albert F. Dawson, former member of Congress from the district; presentation of the building to the Department of Commerce, by Professor James M. White, architect; acceptance of the laboratory on behalf of the Department of Commerce and delivery to the Bureau of Fisheries, by Hon. Edwin F. Sweet, assistant secretary of commerce, with address on "Federal and State responsibility for maintaining resources of interstate waters"; response by Dr. Hugh M. Smith, Commissioner of Fisheries; address on "Significance of the station to industries," by Hon. Harry E. Hull, member of Congress; address on "Aquiculture and science," by Dr. Edward A. Birge, president of the University of Wisconsin; address on "The spirit of cooperation in the Bureau of Fisheries," by Professor Frank R. Lillie, University of Chicago; address on "The fisheries biological station in relation to the universities," by Professor George Lefevre, University of Missouri; and address on "The station as an aid to pure science," by Professor Charles C. Nutting, University of Iowa.

On the day following the dedicatory exercises there was held in the laboratory building a conference regarding the application of science to the utilization and preservation of the resources of interior waters. The chairman of the conference was Professor S. A. Forbes, University of Illinois, and the principal address was by Professor James G. Needham, Cornell University, on "The biological resources of our inland waters."

THE CHICAGO MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE history of science is to be a part of the field covered by the new Section L (Historical and Philological Sciences) of the American Association for the Advancement of Science. A temporary committee to have charge of the organization of this aspect of Section L has been appointed by the President of the Association. The personnel of this committee is as follows: Dr. William A. Locy (chairman), Northwestern University, Evanston, Ill.; Mr. Frederick E. Brasch (secretary), The John Crerar Library, Chicago, Ill.; Dr. Florian Cajori, University of California, Berkeley, Calif.; Professor A. P. Carman, University of Illinois, Urbana, Ill.; Professor Henry G. Gale, University of Chicago, Ill.; Dr. Charles Judson Herrick, University of Chicago, Chicago, Ill.; Dr. Felix Neumann, War Department, Washington, D. C.; Dr. George Sarton, Harvard University, Cambridge Mass.; Dr. William H. Welch, The Johns Hopkins University, Chicago, Ill. A program on the History of Science is being planned for the approaching Chicago meeting.

In accordance with a recent action of the executive committee of the council of the American Association, the president of the association has appointed a special committee to cooperate with the officers of the new Section H (Anthropology), to organize the section and prepare a program for the Chicago meeting. The vice-president of the new section is Dr. A. E. Jenks, University of Minnesota, Minneapolis, Minn. The secretary is Dr. E. A. Hooton, Peabody Museum, Cambridge, Mass. The special committee just appointed has the following personnel: Dr. Clark Wissler (Chairman), American Museum of Natural History, New York, N. Y.; Dr. G. G. MacCurdy (Secretary), Yale University, New Haven Conn.; Dr. Roland B. Dixon, Harvard University, Cambridge, Mass.; Dr. J. Walter Fewkes, Bureau of American Ethnology, Smithsonian Institution, Washington, D. C.; Dr. Aleš Hrdlička, U. S. National Museum, Washington, D. C.; Dr. A. L. Kroeber, University of California, Berkeley, Calif.; Dr. F. G. Speck, University of Pennsylvania, Philadelphia, Pa.

One of the general-interest, evening sessions of the approaching Chicago meeting of the American Association for the Advancement of Science will be devoted to an illustrated lecture by Dr. R. F. Griggs, of Ohio State University, on his exporations and studies in the volcanic region of Katmai, Alaska. The date and place of this lecture will be announced in the general program, which will be available before the opening of the meeting on December 27.

SCIENTIFIC SOCIETIES MEETING AT CHICAGO

THE following national scientific societies will meet at Chicago during convocation week in affiliation with the American Association for the Advancement of Science. The name of the president is followed by the name of the secretary.

American Mathematical Society: Dr. F. N. Cole secretary.

Mathematical Association of America: Dr. David Eugene Smith, Dr. W. D. Cairns.

American Astronomical Society: Dr. Frank Schlesinger, Dr. Joel Stebbins.

American Physical Society: Professor J. S. Ames, Dr. Dayton C. Miller.

American Meteorological Society: Dr. Robert DeC. Ward, Dr. Chas. E. Brooks.

American Metric Association: Mr. Howard Richards, Jr., sec'y.

Optical Society of America: Dr. F. K. Richtmyer, Dr. P. D. Foote.

Geological Society of America: Dr. I. C. Morgan, Dr. E. O. Hovey.

Association of American Geographers: Dr. Herbert E. Gregory, Dr. Richard E. Dodge.

National Council of Geography Teachers: Professor R. H. Whitbeck, Professor Geo. J. Miller.

Paleontological Society of America: Dr. F. B. Loomis, Dr. R. S. Bassler.

American Society of Naturalists: Dr. Jacques Loeb, Dr. A. Franklin Shull.

American Society of Zoologists: Dr. Gilman A. Drew, Dr. W. C. Allee.

Entomological Society of America: Dr. J. M. Aldrich, Sec'y.

American Association of Economic Entomologists: Dr. Wilmon Newell, Mr. A. F. Burgess.

American Microscopical Society: Professor T. W. Galloway, Dr. Paul S. Welch.

Wilson Ornithological Club: Dr. R. M. Strong, Mr. Albert F. Ganier.

Botanical Society of America: Dr. N. L. Britton, Professor J. R. Schramm.

American Phytopathological Society: Dr. W. A. Orton, Dr. G. R. Lyman.

Ecological Society of America: Dr. Barrington Moore, Professor A. O. Weese.

American Society for Horticulture Science: W. H. Alderman, Dr. C. P. Close.

Association of Official Seed Analysts: Edgar Brown, A. L. Stone.

American Nature Study Society: J. A. Drushel, Mrs. A. B. Comstock.

American Physiological Society: Professor W. P. Lombard, Dr. C. W. Greene.

American Society of Biological Chemists: Dr. Stanley R. Benedict, Professor Victor C. Myers.

American Society for Experimental Pathology: Dr. William H. Park, Dr. H. T. Karsner.

American Society for Pharmacology and Experimental Therapeutics: Dr. A. S. Loevenhart, Dr. E. D. Brown.

American Society of Bacteriologists: Dr. Chas. Krumwiede, Dr. A. Parker Hitchens.

American Anthropological Association: Dr. Clark Wissler, Dr. Alfred M. Tozzer.

American Folk-Lore Society: Dr. Charles Peabody, Sec'y.

American Psychological Association: Dr. Shepherd I. Franz, Dr. E. G. Boring.

American Association of University Professors: Professor Edward Capps, Professor H. W. Tyler.

Society of Sigma Xi: Dr. C. E. McClung, Dr. H. B. Ward.

Gamma Alpha Graduate Fraternity: Dr. J. R. Musselman, Dr. A. H. Wright.

Gamma Sigma Delta: Dr. C. H. Eckles, Dr. L. H. Pammel.

Phi Kappa Phi Fraternity: Dr. J. S. Stevens, Dr. L. H. Pammel.

CENTENARY OF THE MEDICAL COLLEGE OF THE UNIVERSITY OF CINCINNATI

ON Saturday, November 6, the Medical College celebrated the centennial of its founding. One hundred years ago the Medical College of Ohio received its charter from the state with Dr. Daniel Drake, whose name is written deeply in the annals of American medical history, as its first president. The Medical College of the University was the first medical school established west of the Alleghenies and is the third oldest in the country, Harvard and Pennsylvania alone taking precedence.

The college, then called the Medical College of Ohio, had its beginning in a little room above a drug store on Main street. Dr. Daniel Drake, the father of the college, graduated the first class of twenty-four students from this little room in 1821.

In 1896 the Ohio College became the med-

ical department of the University of Cincinnati, and in 1909 the Miami Medical College also become a part of the university.

The building of the present medical college and the city hospital was largely the achievement of Dr. Christian R. Holmes, through whose efforts the University of Cincinnati Medical College has taken front rank in medical education.

At the exercises on November 6, Dr. J. C. Oliver gave a historical sketch of the college and Dr. William T. Sedgwick, of the Massachusetts Institute of Technology, spoke on the relationship of medicine to public health. Dr. Joseph Ransohoff reviewed work of Drake and Holmes and other teachers in the college. Following the addresses, honorary degrees were conferred, and a portrait in oil of Dr. Christian R. Holmes was unveiled.

At the banquet in the evening the principal address was made by the British Ambassador, Sir Auckland Geddes, formerly professor of anatomy at McGill University. President Frederick C. Hicks was the toastmaster and other speakers were: Hon. John Galvin, Judge John Barton Payne, Dr. James R. Angell, Dr. Charles R. Stockard and Dr. Louis Schwab.

Honorary degrees conferred were as follows: Doctor of laws, James Rowland Angell, President of the Carnegie Foundation; Mrs. Mary Muhlenberg Emery; Sir Auckland Geddes; Ludwig Hektoen; professor of pathology, University of Chicago; Christian R. Holmes; Frederick S. Novy, professor of bacteriology, University of Michigan; Hon. John Barton Payne, secretary of the interior; Joseph Ransohoff, professor of surgery, London; William Thompson Sedgwick, professor of biology and public health, Massachusetts Institute of Technology; Louis Schwab, physician. Doctor of science: Charles Cassidy Bass, professor of experimental medicine, Tulane University; Ross Granville Harrison, professor of comparative anatomy, Yale University; Dean DeWitt Lewis, professor of surgery, University of Chicago; Robert Williamson Lovett, professor of orthopaedic surgery, Harvard Medical School; Elmer Vernes McCollum, professor of chemical hygiene, Johns Hopkins University; William Snow Miller, University of Wisconsin; Charles R. Stockard, professor of anatomy, Cornell Medical College; Henry B. Ward, professor of geology, University of Illinois; John C. Webster, professor of gynecology, University of Chicago; Edwin O. Jordan, professor of bacteriology, University of Chicago.

SCIENTIFIC NOTES AND NEWS

THE American Society of Mechanical Engineers, which will hold its annual meeting from December 7 to 10, in the Engineering Societies' Building, New York City, has arranged a memorial program in honor of Dr. John Alfred Brashear, scientific man and maker of astronomical instruments, who died last April in Pittsburgh at the age of eighty years. The principal eulogy of Dr. Brashear will be delivered by Dr. Henry S. Pritchett, president of the Carnegie Foundation for the Advancement of Teaching.

DR. WILLIAM C. BRAISTED, surgeon-general, U. S. Navy, and president of the American Medical Association, has been awarded the Navy distinguished service medal for meritorious service during the war.

A PORTRAIT of Dr. William S. Miller, professor of anatomy in the University of Wisconsin Medical School, has been formally presented to the university at exercises held in Science Hall. The portrait was painted by Christian Abrahamson and is the gift of Dr. Miller's colleagues, friends in the medical profession, and former students.

DR. BERNARD L. WYATT, of the Rockefeller Institute, has been made a knight of the Legion of Honor of the French Republic in recognition of his services in organizing the French campaign against tuberculosis.

PROFESSOR T. W. EDGEWORTH DAVID, professor of geology in the University of Sydney, has been appointed a knight commander of the Order of the British Empire for services in connection with the war.

PROFESSOR F. O. BOWER has been elected president of the Royal Society of Edinburgh

and Professor D. Noël Paton, Professor A. Robinson, Sir A. Berry, Professor W. Peddie, Sir J. A. Ewing and Professor J. W. Gregory, have been elected vice-presidents.

AT the recent session of the board of trustees held in Chicago, Dr. Rudolph Matas, New Orleans, was elected vice-president of the American Medical Association, succeeding the late Dr. Isadore Dyer.

PROFESSOR C. B. RIDGAWAY, head of the department of mathematics, at the University of Wyoming, is retiring after twenty-four years of service.

DR. ALEXANDER L. MCKAY, Toronto, has accepted an appointment with the Rockefeller Foundation Medical Research Committee.

MR. A. V. BLEININGER, ceramic chemist and head of the ceramic division of the Bureau of Standards, has resigned to become research chemist for the Homer-Laughlin China Company, of East Liverpool, Ohio.

PROFESSOR CLARENCE E. MICKEL has resigned as extension entomologist, college of agriculture, University of Nebraska, to accept a position as research entomologist with the American Beet Sugar Company, Rocky Ford, Colorado.

H. S. MULLIKEN, of Lexington, Mass., has been appointed metallurgical engineer of the Bureau of Mines, and has been assigned by Dr. F. G. Cottrell, the director, as an assistant to him in special professional work connected with the bureau.

PROFESSOR VICTOR LENHER, of the department of chemistry of the University of Wisconsin, has recently been chosen a member of the advisory committee which has been established by the Smithsonian Institution, Washington, to be concerned with the collection of chemical types. The collection was undertaken by the National Museum under the will of Morris Loeb, of New York, who left a fund to the American Chemical Society for chemical research work.

PROFESSOR EDWARD J. KUNZE, head of the department of industrial engineering at the Pennsylvania State College, was elected a director and vice-president in charge of research, of the Society of Industrial Engineers at their recent convention in Pittsburgh on November 10.

MR. F. V. MORLEY, of the Johns Hopkins University, has been appointed a Rhodes scholar at Oxford University.

DR. SOLOMON LEFSCHETZ, professor of mathematics at the University of Kansas, is absent on leave during this academic year and is at present in Europe.

BARON GERARD DE GEER, professor at the University of Stockholm, delivered a lecture before the students and faculty of the Department of Geology at the University of Minnesota on November 5. The lecture was on his geochronological investigations in Sweden and their application to the Quaternary geology of America.

DR. HIDEYO NOGUCHI, of the Rockefeller Institute for Medical Research, of New York, gave a lecture to the faculty and students of the Army Medical School on November 17, on "Recent studies of yellow fever," at the auditorium of the National Museum.

ON October 28, Professor Daniel Hull, assistant superintendent of the El Paso High School, gave under the auspices of the Southwestern Division, of the American Association, a lecture on "The glacial periods of North America and their relation to astronomy." Before the lecture the tentative program of the coming first annual meeting of the Southwestern Division was announced. The meeting will be held in El Paso on December 2, 3 and 4. Other lectures in El Paso are announced as follows: Mr. R. R. Coghlan, on "Chemistry and manufacture of cement;" November 9, Professor W. H. Seamon, on "Prehistoric mammals," illustrated with lantern slides, on November 16.

A COURSE of twelve free Swiney lectures on geology is being given by Dr. J. D. Falconer, of the Royal School of Mines, South Kensington, beginning on November 8. The subject is "The Modelling of the Earth's Crust."

THE *Journal* of the American Medical Association reports that a national committee

has been at work during the year since the death of Dr. J. G. Hermández, of Caracas, and recently completed its labors by unveiling an oil portrait in the university, with memorial tablet, and also a monument in the cemetery, and founding a biennial prize in his name with a fund of 15,770 bolivars. The tablet and monument bear the inscription "Homenaje Nacional." The ceremonies included a large representative gathering and addresses, with music. in the university, and also ceremonies in the cemetery.

In the recent California referendum the bill prohibiting vivisection was defeated by an overwhelming majority. The other anti-health measures, including anti-vaccination were also defeated.

Under date of August 13 Captain Roald Amundsen, the Arctic explorer, sent the following telegram from East Cape, Siberia: "We sailed from Nome immediately after my wire of August 8, with only three men, as the others claimed wages of £300 sterling monthly. The following day we were held up by pack ice in Behring Sea. All aboard well."

In the fire which destroyed the Agricultural building of the Alabama Polytechnic Institute on October 17, the department library, which probably contained the best collection of American and foreign journals in the south, was destroyed. The plant collections of Underwood, Earle and Atkinson which were part of the department herbarium were burned as was also the research equipment of the department. Dr. Wright A. Gardner and Mr. G. R. Johnstone lost their entire botanical libraries.

The Yale Corporation has made arrangements for the establishment of four fellowships, to be known as Bishop Museum Fellowships, and to be awarded for study and research in anthropology, botany, zoology, geology and geography. The fellows are to be appointed by the corporation of Yale University from candidates recommended by the trustees of the Bishop Museum in Honolulu. They will receive $1,000 a year. Their researches, which are to be in the general field of the science of the Pacific, are to be submitted to the Bishop Museum for publication. Applications for fellowships should be made to the dean of the graduate school of Yale University, or to the director of the Bishop Museum in Honolulu.

The will of General Rush C. Hawkins gives the residue of his estate to Norwich University at Northfield, Vt. The will also makes specific public bequests of more than $400,000, including $100,000 to the University of Vermont, and $100,000 to Brown University. Of his bequest to Norwich University General Hawkins said he made it because he believed "above all else in a military education, its tendencies being to develop self-respecting, men, who are more likely than others to be faithful in all relations, which should adorn decent society. I am proud of the records made by the Norwich graduates in the field and at sea whenever they have been called upon to serve their country." General Hawkins left $100,000 to the Society for the Prevention of Cruelty to Animals, of which he had been a director, with the instruction that the income of this bequest be used "to abate the wicked horrors of vivisection and to compel those who practise it to make known to the public the actual methods of their unspeakable calling."

Through the courtesy of the director of naval communications and the commissioner of lighthouses, the Bureau of Fisheries has made arrangements to have the occurrence of schooling fishes reported by the keepers of Pollock Rip, Nantucket Shoals, and Fire Island Lightships. Messages will be sent by radio from each of these vessels at noon daily, reporting any observations which may be made during the preceding 24 hours. The reports will be relayed over the leased wires of the Navy from New York or Newport to Boston Navy Yard, whence they will be communicated by telephone to the Bureau's representative, F. F. Dimick, who will post them at the Fish Exchange and give them such other publicity as may be desirable. Important information of interest to Gloucester fishermen will be telegraphed to Henry F.

Brown, the Bureau's representative at that port, for appropriate publication. The service is being established near the close of the season, but it is desired to have it in working order, so that it may be efficient on the resumption of more active fishing in the spring, when it is hoped to extend it to the coast of Maine.

UNIVERSITY AND EDUCATIONAL NEWS

A GIFT of $700,000 to the University of Colorado for the construction of a medical school and hospital by the General Education Board of the Rockefeller Foundation is announced.

Two bequests to Yale University are announced, one of $46,360 from the late Allen P. Lovejoy, of the class of 1904, of Janesville, Wisconsin, for general university purposes, and one of about $113,000 from the estate of Levi I. Shoemaker, of Wilkes-Barre, Pa.

THE president of Argentina has approved the law ordering the immediate construction of a surgical institute for the chair at Buenos Ayres in charge of Professor José Arce. Four hundred thousand dollars have been provided for this work.

THE following changes have been made in the pathological chemistry staff of the New York Post-Graduate Medical School and Hospital: George Eric Simpson, Ph.D., has resigned as instructor to become assistant professor of biochemistry at McGill University. James J. Short, M.D., has resigned as instructor to complete his interneship in the hospital. To fill this latter position, Hilda M. Croll, A.M., formerly associate professor of physiological chemistry at the Woman's Medical College of Pennsylvania, has been made associate. Cameron V. Bailey, M.D., has been appointed assistant professor, to devote his time largely to respiratory and metabolic work.

THE department of physics, West Virginia University, reports the following additions to the staff: Fred A. Molby, Ph.D. (Cornell); formerly of the University of Cincinnati, associate professor. E. F. George, Ph.D. (O. S. U.), formerly of the Research Laboratory of B. F. Goodrich Rubber Company, assistant professor. O. R. Ford, B.S. (Salem), instructor.

MISS LOUISE OTIS, a graduate of Northwestern University, formerly chief chemist of The Arco Company, Cleveland, O., and recently chemist with Glenn H. Pickard, of Chicago, has been appointed instructor in food chemistry at Northwestern University.

PROFESSOR H. H. CONWELL, associate professor of mathematics in the University of Idaho, has resigned to accept a similar position in Beloit College.

DISCUSSION AND CORRESPONDENCE

A POSSIBLE RELATION BETWEEN MECHANICAL, CHEMICAL AND ELECTRICAL QUANTITIES

TO THE EDITOR OF SCIENCE: It is always of interest to find an unexpected numerical relation between different physical constants, and when the only numerical factor turns out to be a multiple of 10, one is led to expect that in the absolute system it is a rational, unity relation, if the units are properly chosen.

At present the numerical connecting link between chemical and electrical quantities is the electrochemical equivalent of silver, an empirically determined constant whose accepted value now is 0.00111800 gram per coulomb. If this value were only about 3/10 of 1 per cent. higher the writer has found the following curious and totally unexpected relation would be true for all the elements:

$$\text{grams} \times g = 10 \times \text{coulombs} \times \text{atomic weight} / g.$$

in which g is the acceleration of gravity numerically equal to 980.597; it will be noticed that the only coefficient is 10. The faraday (the number of coulombs per gram ion) then would be equal to $g^2/10 = 96{,}157$, now generally taken as 96,500. The first term (grams $\times\, g$) represents a force in dynes, if the grams represent a mass. The physical meaning of the right hand term is not clear, but to balance the physical dimensions the factor

"atomic weight/g" would have to be a force divided by a quantity of electricity, which quotient is called the intensity of an electric field. The atomic weight would then have to be taken to represent something more than a mere number or ratio.

It was thought that perhaps the elimination of all terrestrial factors like the atmospheric pressure, temperature, attraction of gravitation, etc., from the value of this electrochemical constant thereby reducing it to absolute terms which are independent of this earth, might perhaps raise its value by this small amount of 3/10 of 1 per cent., though the writer has been informed by very reliable authorities that it seems unlikely that such corrections would equal this amount. Unless this very slight discrepancy can be adjusted it would seem that this curious relation is a mere accidental coincidence of numbers. But when we are asked to believe that masses change with changes of velocities, that is, with accelerations, and that the atoms of the chemical elements are made up of electrons (electric charges) in very rapid orbital motions, again involving accelerations, so-called, it does not seem unreasonable to believe that new and unexpected relations may be found to exist between mechanical, chemical and electrical constants.

Carl Hering

Philadelphia,
October 13, 1920

THE INFLUENCE OF DRY VERSUS FRESH GREEN PLANT TISSUE ON CALCIUM METABOLISM

In Science, 1920, LII., 318, Hart, Steenbock and Hoppert explain negative calcium balances on dry feed in their experiments, as well as those of Forbes and Meigs, on the destruction of a hypothetical antirachitic vitamine by drying. Mellanby brings evidence to show that the antirachitic vitamine is the same as fat-soluble-A, which is not destroyed in plants by drying. On the contrary, the antiscorbutic vitamine seems to be greatly reduced by drying except in very acid foods (fruits). The marrow tissue of the bones increases in proportion to the bone proper in scurvy and calcium is apparently lost from the bones in this way. In order to make more exact studies of calcium metabolism on guinea-pigs, I feed them calcium-free diets during and for two days before metabolism periods of three days in length. One day periods were not long enough for definite conclusions to be drawn, but three-day periods on a large enough series of animals seemed perfectly reliable. The animals were under starvation conditions as regards calcium, but this lasted only five days, and examination of their bones did not show differences from animals fed liberal amounts of calcium. Animals that had been on a diet of dried plants fourteen days before the experiment, eliminated twice as much calcium as those that had been on a diet of fresh green plants and which during the experiment received calcium-free orange juice. In case of animals that had been twenty-one days on a dry diet, the difference from the controls was more striking. Scurvy appeared in all the animals on the dry diet. It seems possible, therefore, that the loss of calcium in the experiments of Hart, Steenbock and Hoppert may have been due to scurvy and that it is unnecessary to postulate rickets or an antirachitic vitamine.

E. F. Ross

University of Minnesota

PURCHASES IN GERMANY

To the Editor of Science: Some of the problems connected with the purchase of books, etc., from Germans at the present time have been alluded to several times in Science, and further information may not be out of place.

Somewhat less than a year ago I was offered by a German firm, with whom I had dealt for a score of years before the war, the file of a journal I was desirous of purchasing, for 3,000 marks. Somewhat later I received another offer from the same firm for \$420. A few weeks ago the same was again offered, this time at 22,000 marks, and still more recently at 25,000 marks.

As far as I am concerned, the \$420 is a

satisfactory price, but I do strongly object to paying some 20,000 marks more for the set than would a German in Germany; in other words to having the dealer make that profit out of me.

Professor K. A. Hofmann, speaking before the German Chemical Society, justified the present German procedure in the following words:

Von einzelen unserer ausländischen Mitglieder sind Beschwerden eingegangen, weil wir wegen der Valuta-Verhältnisse das Ausland neuerdings anders behandeln mussten als das Inland. Wie ich kaum hinzuzufügen brauche, handelt es sich hier um Vorübergehende Massnahmen, die mit dem Eintritt normaler Zustände wieder verschwinden werden. Keineswegs, das möchte ich hier ausdrücklich feststellen, haben wir die Absicht, unsere ausländischen Mitglieder prinzipiell anders zu behandlen als die inländischen. Wegen der Entwertung der Reichsmark hatten sich jedoch Verhältnisse herausgebildet, denen zufolge das Ausland unsere Veröffentlichungen für den zwanzigsten Teil des früheren Preises kaufen konnte, während die deutschen Mitglieder das Doppelte zahlen mussten. Der Vorstand, welchem satzungsgemäss die Festsetzung der Preise unserer Veröffentlichungen zusteht, hat dann, vielfachen dringenden Anregungen aus Mitgliederkreise entsprechend, die Auslandspreise erhöht und so festgesetz, dass unsere ausländischen Mitglieder immer noch weniger zu zahlen haben, als dies früher im Frieden der Fall war. Wir stehen auf dem Standpunkt, dass *ein etwaiger Valuta-Gewinn einsig und allein der Gesellschaft zusteht, nicht aber dem einzelnen ausländischen Mitgleid.* (Italics ours.) . . . Glaubt man, wir würden hier beschliessen, die 'Berichte' im Ausland für ½, das 'Zentralblatt' für ½ und die beiden ersten Bände des 'Beilstein' für zusammen 1 dollar zu verkaufen? Jedes Buch hat doch einen bestimmten Welthandelswert, und der muss aufrecht erhalten werden.

From the German standpoint this sounds very reasonable, but take the case of the "Berichte." The subscription in Germany and Austria is 45 marks; in America it is \$7.50. At present exchange (1.13) \$7.50 in American money is worth 664 marks in Berlin. In other words, an American pays more than 650 marks for that which is sold to a German for 45 marks.

In a recent publication I noticed the following extract from a German firm to an American customer, whose name had given the impression that he was a German:

A word about prices. I take it from your name and connections that you are of German family and am therefore prepared to make most liberal terms. As you doubtless know, it has been generally agreed in commercial circles here that all articles sold to *uitlanders*, and especially to Americans, shall be priced considerably higher than the same thing sold to our fellow-citizens, the idea being to in this way recuperate to some extent from our late overwhelming losses and to make our recent enemies aid us in paying our most outrageous and crushing war debt.

This policy has been adopted *en bloc* by our associated . . . since some time. But as a fellow German, I am prepared to let you have these goods at the Berlin price, this of course being in all confidence, my most dear sir.

What course should a purchaser take who wishes to deal fairly, not only to the Germans, but to himself?

Jas. Lewis Howe

SCIENTIFIC BOOKS

Psychology of Nationality and Internationalism. By W. B. Pillsbury. D. Appleton and Company, New York and London. 1920. Pp. 314.

The phenomena of collective life have in recent days evoked a great number of half-analyzed conclusions and assertions. A welcome relief from these is the present book, which represents the analysis of one whose point of view is supported by a background of empirical science. There is undertaken an analysis of the nature and development of the national consciousness, and of the place of the nation as an ideal in history, in the conduct and thought of individuals, and in the relations of states to each other.

Definitions of the nation are submitted to criticism. Neither language nor descent gives the key to the common spirit of a nation. Nor is the nation merely an extension of familial or tribal organization. Nationality is first of all a psychological and sociological problem.

It is the common ideals of its members that make the nation. To know to what national group an individual belongs the simplest way is to ask him.

The instinctive gregarious and sympathetic reactions, the fear of group disapproval, these give the constitutional basis, which explain why there is any grouping at all. But it is the acquisition of common ideals, within the individual's own life, that gives the group its persistent unity and determines its membership. The nation as an ideal exists only in the minds of its separate members, but when it does exist it unites them for action. It becomes a common center of thought and emotion, its prestige determines the conduct of the individual in much the same way as does his concept of his self. Although the social mind is but a metaphor, the nation, as a concept, is as real as is the self of the individual, and in the same sense. But the original instincts, the thoughts, the acts, are the instincts, thoughts and acts of individuals, throughout, and the ideals exist only in individual minds, which are themselves always changing in identity.

The development of the nation as a common ideal or concept is favored by, but does not depend solely upon, such incidents as a common ancestry, language, literature, historical continuity, a home land, and definite geographical boundaries. It is especially favored by the urgencies of common danger and the ensuing development of common hatreds of opposing groups. A common hate is one of the most frequently effective factors in making or uniting a nation or a smaller group within the nation. Common fears and animosities in all wars, rather than mutual sympathy and admiration, are what bind the allies into a solid whole. Nationality thrives on opposition.

Since nationality is acquired rather than innate, its affiliations may under appropriate conditions be changed and its loyalties shifted. A chapter is given to the process of naturalization, its conditions, aids, and objective signs. In part the aids to naturalization and amalgamation are identical with those that led to the development of nations in history. Especially useful are change of habits, language, standards of living. Effective also are the pressure of contempt, group approval of those who change, influence of children who adopt the new ideals and scorn the old. Even race prejudice is seen to play its part as an aid to change in nationality.

The development of the national ideals and standards and the peculiarities of the ideals of different nations are illustrated by sketches of the rise of national spirit in the ancient and modern states. Accounts of the nation as a mob are critically examined and found in the main false. For the most part the nation thinks as does a sane individual in isolation, and the final decisions usually attain the level of the average intelligence. The results of this thinking, the successful conventions and approved ideals, are embodied in the law, in formal government, and the machinery of the state. The relation of the state to the nation is that the state embodies and provides a means for realizing the ideals of the nation. Naturally the means lags behind the ideals.

Whether nationality represents the extreme development of organization or whether it is possible to go beyond and find a larger unity in a community of states is considered in the last chapter. Smaller group loyalties within the nation are shown not to prevent but rather to facilitate the growth of national spirit. So might the rivalry of nations be made an element in inciting to progress in the international community. In no single respect does the psychology of nationality offer any reasonable objection to the formation of an international society or League of Nations, although the super-national state might have to rely to greater degree on the more cooperative instincts, in the absence of the thrilling and amalgamating influence of a common hate.

This review can not hope to give an adequate summary of the book, with its many pertinent problems, its sane and reasonable analysis of them, and its keen interpretation of social phenomena always on the ground that all psychology is of individuals. The failure

to distinguish clearly between "the group" and what we may designate as "unspecified individuals"; the use of the term "society" for forgotten sources of suggestion or for influential individuals, may be occasionally disappointing to the reader whose psychology is still more individualistic than that of the author. The conclusion that low intelligence is not an innate but "merely an acquired characteristic" may not seem necessarily to follow from the evidence presented, and is at least at variance with current views concerning the nature of intelligence. But these are minor points. The general reader and the specialist alike will welcome the book as a substantial contribution to the subject of collective psychology.

H. L. Hollingworth

CALL FOR A MEETING OF GENETICISTS INTERESTED IN AGRICULTURE

There is a steadily increasing number of teachers and investigators in the country interested in genetics in its relation to agriculture. The greater proportion of these are connected with agricultural colleges and experiment stations, and in this relationship they encounter a distinctive set of problems and responsibilities. These include questions of organization, scope of teaching and investigation, cooperation, relation to extension activities, and the like. As an example, take the matter of organization, which involves both intradepartmental and interdepartmental relations. Is it preferable that the genetics work and workers in an institution should be brought together in a single departmental organization, or can the interests of the institution, the students and the investigational projects be best served by having different geneticists on the staff attached to such existing departments as animal husbandry, horticulture and agronomy? Each of these plans doubtless has its advantages and its disadvantages.

The question of where and by whom the elementary course in genetics should be taught, and what its scope should be, is another important question on which practise varies greatly in different institutions. To what extent, if at all, should investigators in agricultural experiment stations be limited in their investigations to projects which have more or less immediate practical application? And to what extent can the results of recent advances in genetics be put before the practical breeder and be made of use to him? These examples will serve to indicate the nature of some of the problems which face the geneticists in agricultural institutions. It is felt by those whose names are appended to this letter that much benefit might be derived from a conference of such workers, at which these and other similar questions might be discussed, since mutual advantage could doubtless be derived from the ideas and experience of others. To this end we are proposing that an attempt be made to arrange for such a conference to be held in connection with the meetings of the American Association for the Advancement of Science and affiliated societies in Chicago this winter. The most feasible date can not be stated at this time; it might be necessary, in order to avoid conflicts, that those interested in this project should come a day earlier or stay over a day later than the other meetings.

The organization of a formal society is not at present contemplated, and it should be emphasized that it is not proposed to have a meeting for the presentation of technical papers in genetics, provision for which is already made on the programs of various societies. This is contemplated purely as a conference for the discussion of the problems peculiar to the geneticists of agricultural institutions or other persons interested in the application of genetics to agriculture. Correspondence and suggestions are solicited from all who may be interested in promoting or attending such a meeting. Address communications to L. J. Cole, College of Agriculture, University of Wisconsin, Madison, Wis.

E. B. Babcock, professor of genetics, University of California.

Leon J. Cole, professor of genetics, University of Wisconsin.

G. N. Collins, Bureau of Plant Industry, Washington, D. C.

J. A. Detlefsen, assistant professor of genetics, University of Illinois.

R. A. Emerson, professor of plant breeding, Cornell University.

H. D. Goodale, biologist, department of poultry husbandry, Massachusetts Agricultural College.

John W. Gowen, biologist, Maine Agricultural Experiment Station.

H. K. Hayes, professor of plant breeding, University of Minnesota.

D. F. Jones, department of plant breeding, Connecticut Agricultural Experiment Station.

William A. Lippincott, professor of poultry husbandry, Kansas State Agricultural College.

Edward N. Wentworth, Armour's Bureau of Agricultural Research and Economics, Union Stock Yards, Chicago.

Sewall Wright, senior animal husbandman, Bureau of Animal Industry, Washington, D. C.

DOCTORATES CONFERRED IN THE SCIENCES BY AMERICAN UNIVERSITIES IN 1920. II

ENGINEERING

Columbia: Mortimer Thomas Harvey, "Bakelite intermediates." Frank Abraham Struss, "Benzoic acid from benzine."

George Washington: Alanson David Morehouse, "Rainfall and run-off and the hydraulics of drainage ditches."

Johns Hopkins: Frederick William Lee, "Electric strength of air under continuous potentials and as influenced by temperature."

Wisconsin: Harold Marion Crothers, "Selective properties of coupled radio circuits."

GEOGRAPHY

Harvard: Roderick Peattie, "Geographic conditions of the lower St. Lawrence Valley."

Wisconsin: Leonard Bayliss Krueger, Title of thesis not given. Selma Langenhan Schubring, "A statistical study of lead and zinc mining in Wisconsin."

Geology

California: Nicholas Lloyd Taliaferro, "Manganese deposits of the Sierra Nevada of California." Frank Samuel Hudson, "Geology of the Cuyamaca region, California, with special reference to the origin of the nickeliferous pyrrhotite."

Chicago: Paul MacClintock, "Pleistocene history of the lower Wisconsin Valley." Bertram Reid MacKay, "Geology and physiography of the Beauceville map area, Quebec, with special reference to placer gold deposits." Horace Noble Coryell, "Bryozoon fauna of the Stones River formation of central Tennessee." Ralph Works Chaney, "Flora of the Eagle Creek Formation."

Illinois: Clarence Samuel Ross, "Differentiation and contact metamorphism of the Snowbank syenite in the Vermillion iron bearing region of Minnesota." Luther Eugene Kennedy, "Cacaquabic granite and porphyry and their contact effects."

Massachusetts: George Hanson, "Some Canadian occurrences of pyritic deposits in metamorphic rocks."

Minnesota: Arthur Jerrold Teije, "Cambrian sedimentation in the Big Horn Mountains."

Princeton: Benjamin Franklin Howell, "Cambrian paradoxides beds at Manuels, Newfoundland."

Yale: William Sidney McCann, "Geology and mineral deposits of the Bridge River map-area, British Columbia." Chester Ray Longwell, "Geology of the Muddy Mountains, Nev., with a section to the Grand Wash Cliffs in Arizona." George Sherwood Hume, "Stratigraphy and geologic relations of the Paleozoic outlier of Lake Timiskaming, Ontario." Kirk Bryan, "Geology, physiography, and water resources of the Papago Country, Arizona." Walter Andrew Bell, "Stratigraphy of the Horton-Windsor District, Nova Scotia."

MATHEMATICS

Bryn Mawr: Bird Margaret Turner, "Plane cubics with a given quadrangle of inflexion."

California: Elsie Jeanette McFarland, "On a special quartic curve."

Chicago: Cyril Arthur Nelson, "Conjugate systems with conjugate axis curves." Gladys Elizabeth Carson Gibbens, "Comparison of different line-geometric representations for functions of a complex variable." John Wayne Lasley, Jr., "Some special cases of the flecnode transformation of ruled surfaces." William Lloyd Garrison Williams, "Fundamental systems of formal modular seminvariants of the binary cubic."

Columbia: Emil L. Post, "Introduction to a general theory of elementary propositions."

Cornell: George Merritt Robinson, "Divergent double sequences and series."

HARVARD: Hyman Joseph Ettlinger, I. "Existence theorems for the general real self-adjoint linear system of the second order. II. Oscillation theorems for the real self-adjoint linear system of the second order." Joseph Leonard Walsh, "On the location of the roots of the Jacobian of two binary forms."

ILLINOIS: Roscoe Woods, "Elliptic modular functions associated with the elliptic norm curve E." Charles Francis Green, "On the summability and regions of summability of a general class of series of the form sigma cng $(x+n)$." Leonard Leo Steimley, "On a general class of series of the form sigma cng $(n-x)$."

MICHIGAN: John David Bond, "Plane trigonometry in Richard Wallingford's quadripartitum de sinibus demonstratis." Susan Miller Rambo, "Point of infinity as a regular point of certain linear difference equations of the second order."

PRINCETON: Edward Sanford Hammond, "Periodic conjugate nets of curves." Henry Roy Brahans, "Curves on surfaces."

SYRACUSE: Tsao-Shing Yang, "Moving trihedral associated with a triply orthogonal system of surfaces—theory and application." Jason John Nassau, "Some theorems in alternants."

WISCONSIN: Thornton Carle Fry, "Use of divergent integrals in the solution of differential equations."

Pathology

CALIFORNIA: Hilda Hempl Heller, "Etiology of acute gangrenous infections of animals: a discussion of blackleg, brazy, malignant œdema, and whale septicæmia."

MINNESOTA: Carl Arthur Hedblom, "Treatment of chronic empyema." Georgine Luden, "Influence of cholesterol metabolism and other factors in carcinoma."

Physics

CALIFORNIA: Charles Henry Kunsman, "Study of the residual ionization in gases with reference to temperature effects."

CHICAGO: John Bewley Derieux, I. "Use of mercury droplets in Millikan's experiment. II. Photoelectric effects on mercury droplets." Ralph Alanson Sawyer, "Metallic spark spectra in the extreme ultra violet." Mervin Joe Kelly, "Valency of photo-electrons and the photo-electric properties of some insulators." Harold Horton Sheldon, "Charcoal activation." Oswald Hance Blackwood, "On the existence of homogeneous groups of large ions." Ira Garnett Barber, "Secondary electron emission from copper surfaces." Otto Koppius, "Comparison of thermionic and the photoelectric work-functions in platinum."

CINCINNATI: Harold Frederick Richards, "Electrification by impact."

CORNELL: Austin Bailey, "Study of the effect of adsorbed gas on the high frequency resistance of copper wire."

HARVARD: Yu Ching Wen, "Theoretical treatment of the radiation resistance of antennæ excited by damped and undamped waves at all ranges of wave-lengths." Elmer Raymond Schaeffer, "Atmospheric attenuation of ultra-violet light." David Arnold Keys, "On a piezo-electric method of measuring explosion pressures."

ILLINOIS: William Henry Hyslop, "A method of determining dielectric constants of liquids by undamped oscillations."

IOWA STATE: George Ray Wait, "Hall effect and the specific resistance of thin silver films." Paul Streeper Helmick, "The blackening of a photographic plate as a function of the intensity of light and time of exposure."

MISSOURI: Francis Marion Walters, Jr., "Wave-length measurements in arc spectra photographed in the yellow, red and infra-red."

OHIO STATE: Enoch Franklin George, "Absorption of light by solutions of inorganic salts."

PENNSYLANIA: George Rosengarten, "Effect of temperature upon the transmission of infra-red radiation through various glasses." John Clarence Karcher, "Wave-length measurements in the M series of some high frequency spectra."

Physiology

CALIFORNIA: John Augustus Larson, "Further evidence on the functional correlation of the hypophysis and thyroid."

CHICAGO: Thomas Leon Patterson, "Studies on gastric hunger contractions in amphidia and reptilia." Lester Reynold Dragstedt, "Studies in acute intestinal obstruction." Bernard Raymund, "Alkali reserve in experimental surgical shock." Emma Anna Kohman, "Experimental production and control of hunger edema."

CLARK: Charles Bird, "Genetic study of hunger."

COLUMBIA: Anna Baker Gates, "The mechanism of the recovery or maintenance of systemic blood pressure after complete transection of the spinal cord."

HARVARD: McKeen Cattell, "Some effects of ether and morphine on the blood and circulation in

shock." Edward Frederick Adolph, "Quantitative study of the interrelations of oxygen and carbon dioxide with hemoglobin in blood."

ILLINOIS: Alma Jessie Neill, "Comparison of the rate of diffusion of certain substances."

INDIANA: Paul Montgomery Harmon, "Influence of temperature and other factors upon the two-submitted contraction curve of the gastronemius muscle of the frog."

JOHNS HOPKINS: Helene Connet, "Effect of adrenalin on the venous blood pressure."

LELAND STANFORD: Rollin Guizot Myers, "Studies on the blood of marine animals."

YALE: George Eric Simpson, "Effect of diet on the excretion of indican and the phenols."

Psychology

CATHOLIC: Othmar Solnitsky, "Factors in economic learning."

CHICAGO: Joseph Ussery Yarbrough, "Influence of time interval upon the rate of learning in the white rat." Chih Wei Luh, "The conditions of retention." Edward Stevens Robinson, "Some factors determining the degree of retroactive inhibition." Guy Thomas Buswell, "Experimental study of the eye-voice span in reading." Forrest Alva Kingsbury, "A group intelligence scale for primary grades." Margaret Wooster, "Certain factors in the formation of a new spatial coordination."

CLARK: Francis Cecil Summer, "Psychoanalysis of Freud and Adler."

COLUMBIA: Dean R. Brimhall, "Family resemblances among American men of science." Evelyn Gough, "Effects of practise on judgments of absolute tone." Myra Elizabeth Hills, "Standardization of the analogies test." Georgina Ida Strickland, "Individual differences as affected by practise."

CORNELL: Hubert Sheppard, "Foveal adaptation to color." Louis Benjamin Hoisington, "On the non-visual perception of the length of lifted rods." Cheves West Perky, "An experimental study of the imagination." Michael Jacob Zigler, "An experimental study of visual form." Homer Guy Bishop, "An experimental investigation of the positive after-image in audition." Claire Comstock, "An experimental study of meaning and imagery." Forrest Lee Dimmick, "Visual movement and the phi phenomenon." Robert Thomas Holland, "The after-image of pressure." Alice Helen Sullivan, "An experimental study of kinæsthetic imagery."

GEORGE WASHINGTON: Dudley Ward Fay, "A psycho-analytic study of some psychoses associated with frank endocrine disorders."

HARVARD: Charles Arthur Coburn, "Heredity of wildness and savageness in mice." George Humphrey, "Conditioned reflex in education." Yueh Tang, "Affective factors in perception." Charles Hart Westbrook, "Measurement of ability in reading." Zenas Clark Dickinson, "Study of the psychological theory of action with reference to economic theory."

ILLINOIS: Coleman Roberts Griffith, "Organic and mental effects of repeated bodily rotation."

INDIANA: Hazel Irene Hansford, "Mental and social survey of a degenerate family." Luella Winifred Pressey, "Measurement of intelligence and school attainment in the first three school grades."

IOWA STATE: Clarence Frederick Hansen, "Serial action as the basic measure of motor capacity."

JOHNS HOPKINS: David June Carver, "Immediate psychological effects of tobacco smoking." Wilbur Harrington Norcross, "Experiments on the transfer of training."

LELAND STANFORD: William Thomas Root, Jr., "Socio-psychological study of 53 supernormal children." James Leroy Stockton, "Definition of intelligence in relation to modern methods of mental measurement." Arthur Sinton Otis, "Absolute point scale for the group measurement of intelligence."

MICHIGAN: Sarah Davina MacKay Austin, "Study in logical memory."

OHIO STATE: Jeanette Chase Reamer, "Mental and educational measurement of the deaf by the group method."

PRINCETON: Edgar Arnold Doll, "Growth of intelligence."

YALE: Arthur Dart Bissell, "Rôle of expectation in music."

Zoology

CALIFORNIA: Henry Homer Collins, "Studies of the pelage phases and of the nature of color variations in mice of the genus *Peromyscus*."

CHICAGO: Benjamin Harrison Willier, "Structures and homologies of free-martin gonads."

COLUMBIA: Clara Julia Lynch, "Unisexual sterility in *Drosophila*." Shellby R. Safir, "Genetic and cytological examination of primary non-disjunction in *Drosophila melanogaster*." Franz Schrader, "Sex determination in the white fly." Mary Bertha Stark, "Hereditary tumor in the fruit fly, *Drosophila*."

CORNELL: Walter Norton Hess, "Studies on the Lampyridæ." Clarence Hamilton Kennedy, "Study of the phylogeny of the Zygoptera." Fred Waldorf Steward, "Development of the cranial sympathetic ganglia in the rat." Benjamin Percy Young, "Attachment of the abdomen to the thorax among Diptera." Laura Florence, "Hog louse, *Hæmatopinus suis*, Linné: its biology, anatomy and histology." Walter Housley Wellhouse, "Insect fauna of the genus *Crataegus*."

GEORGE WASHINGTON: Benjamin Schwartz, "Hemotoxins from parasitic forms." Frank Alexander Wetmore, "Body temperature of birds." Thomas Elliott Snyder, "Colonizing termites."

HARVARD: Vasil Obreshkove, "Photic reactions of tadpoles in relation to the Bunsen-Roscoe Law." James Montrose Duncan Olmsted, "Experiments on the olfactory and gustatory organs of *Amiurus nebulosus* (*Lesueur*)." Herbert Greenleaf Coar, "Shell of *Balanus eburnus*." William Norton Barrows, "Modifications and development of the arachnid palpal claw, with especial reference to spiders." Leslie Clarence Dunn, "Linked genes in mammals." Alfred Charles Kinsey, "Studies of gall-wasps (*Cynipidæ hymenoptera*)."

ILLINOIS: Hachiro Yuasa, "Classification of the larvæ of Tenthredinoidea."

INDIANA: William Marion Goldsmith, "Comparative study of the chromosomes of the tiger beetles (*Cicindelidæ*)." William Ray Allen, "Studies of the biology of freshwater mussels."

IOWA STATE: Gertrude Van Wagenen, "Coral Mussa fragilis, and its development."

JOHNS HOPKINS: Bessie Noyes, "Experimental studies on the life history of a rotifer reproducing parthenogenetically (*Proales decipiens*)." Hoyt Stilson Hopkins, "Conditions for conjugation in diverse races of *Paramœcium*."

KANSAS: Paul Bowen Lawson, "Cicadillidæ of Kansas."

MICHIGAN: Walter Norman Koelz, "Coregonine fishes of Lake Huron."

MISSOURI: Erwin Ellis Nelson, "Chemical composition of the ovaries and skeletal muscle of the fresh water gar, *Lepidosteus*."

PENNSYLVANIA: Joseph Hall Bodine, "Factors influencing the water content and the rate of metabolism of certain Orthoptera."

PRINCETON: Wilbur Willis Swingle, "Germ-cell cycle of *Anurans*. I. The male sexual cycle of *Rana catesfrava*." Elmer Lentz Shaffer, "Germ-cells of *Cicada septemdecim* (Homoptera)."

WISCONSIN: Bert Cunningham, "Some studies in the natural history and early development of *Chrysemys cinerea*." George Holman Bishop, Title for thesis not given. Archie Evans Cole, Title for thesis not given.

YALE: Harry Hayward Charlton, "Spermatogenesis of *Lepisma domestica*." Ruth B. Howland, "Experiments on the effect of removal of the pronephros of *Amblystoma punctatum*."

CALLIE HULL,
Technical Assistant

RESEARCH INFORMATION SERVICE,
NATIONAL RESEARCH COUNCIL

SPECIAL ARTICLES

A METHOD OF STUDYING THE ABSORPTION-TRANSPIRATION RATIO IN NUTRIENT MEDIA

SEVERAL writers have shown that the water content of plants varies with the hour of the day. This variation is of course due to differences in the rates of water entrance and exit. Wilting takes place when the ratio of the rate of entrance to the rate of exit is less than unity whether caused by excessive transpiration or by a decrease in root absorption. These two plant processes may easily be studied as a laboratory exercise in plant physiology by using water culture plants exposed to different environmental conditions or placed in solutions of different osmotic pressures. The following experiment will serve to illustrate the manner in which changes in the strength of solutions affect the ratio of absorption to transpiration. The method here described is practically the same as one used by the writer in a series of experiments reported by Livingston.[1]

The roots of a tomato plant were passed through a hole in the rubber stopper of a large mouth bottle of about 600 c.c. capacity. A water-tight seal of chewing gum was made around the stem of the plant; a 2 c.c. pipette, graduated to 1/20 c.c. and a thermometer were inserted into the bottle through the stopper.

[1] Livingston, B. E., "Incipient Drying and Temporary and Permanent Wilting of Plants, as Related to External and Internal Conditions," Johns Hopkins Univ. Cir., March, 1917, pp. 176–82.

The bottle and pipette were then filled with the nutrient solution, care being taken that no bubbles were inclosed beneath the stopper. Loss in weight of the plant and container gave the amount of transpiration, while the loss of solution from the pipette gave the amount of root absorption after temperature corrections were made. These temperature corrections were made by comparing these pipette readings with those of a pipette in a similar bottle containing no plant, but exposed to the same set of conditions. Transpiration was measured in grams while absorption was measured in cubic centimeters, but as the variations in density of the solutions for these temperature ranges were small in comparison to the actual values dealt with this correction was not made. The experiment was performed on November 6, 1919, in the diffused light of the laboratory during a period when variations in temperature and the index of evaporation were slight.

TABLE I

Data Showing Rates of Transpiration and Absorption of a Tomato Plant with Roots Immersed Successively in a Three-salt Nutrient Solution of 1.75 Atmospheres Osmotic Pressure, Cane Sugar Solution of 5.06 Atmospheres Osmotic Pressure and Distilled Water

Period	Hourly Rate of		Ratio A/T	Solution and Osmotic Pressure
	Transpiration	Absorption		
	gram	*cc.*		
1	.41	.44	1.07	3-salt, 1.75 atm.
2	.31	.37	1.19	3-salt, 1.75 atm.
3	.42	.28	.67	Sugar, 5.06 atm.
4	.29	.18	.62	Sugar, 5.06 atm.
5	.41	.46	1.12	Distilled water
6	.32	.39	1.22	Distil'ed water

When the hourly rate of absorption is in excess of transpiration the ratio, A/T, is greater than unity and the plant cells increase in turgor. When this rate is less than unity turgor is decreased and if the process is continued long enough the cells become flaccid and the plant is seen to wilt. The plant gained in turgor during the first two periods given in Table I., but during the third and fourth periods the ratio values decreased very much. This decrease was mainly due to lower absorption rates since the roots were surrounded by a solution much stronger osmotically during these two periods than during the first two. The rates of absorption for the last two periods were greatly increased by placing the roots in distilled water.

Earl S. Johnston

Laboratory of Plant Physiology,
Maryland Agricultural
Experiment Station

THE AMERICAN MATHEMATICAL SOCIETY

The two hundred and twelfth regular meeting of the society was held at Columbia University on Saturday, October 30, 1920, extending through the usual morning and afternoon sessions. The attendance included thirty-five members. President Morley occupied the chair. The council announced the election of the following persons to membership in the society: Dr. P. M. Batchelder, University of Texas; Miss Vevia Blair, Horace Mann School; Mr. E. H. Carus, La Salle, Ill.; Mr. W. E. Cederberg, University of Wisconsin; Mr. R. P. Conkling, Newark Technical School; Mr. P. H. Evans, Northwestern Mutual Life Insurance Company, Milwaukee, Wis.; Mr. B. L. Falconer, U. S. Civil Service Commission, Boston, Mass.; Mr. J. A. Foberg, Crane Junior College, Chicago, Ill.; Dr. Gladys E. C. Gibbens, University of Minnesota; Professor L. E. Gurney, University of the Philippines; Professor Archibald Henderson, University of North Carolina; Miss Jewell C. Hughes, University of Arkansas; Miss Claribel Kendall, University of Colorado; Mrs. M. I. Logsdon, University of Chicago; Mr. R. L. McNeal, General Motors Laboratories, Detroit, Mich.; Mr. H. L. Olson, University of Michigan; Professor Leigh Page, Yale University; Captain H. W. Rehm, Aberdeen Proving Ground, Md.; Mr. Irwin Roman, Northwestern University; Mr. Raleigh Schorling, Lincoln School, New York City; Mr. E. L. Thompson, Junior College, Joliet, Ill.; Dr. Bird M.

Turner, University of Illinois. Four applications for membership in the society were received.

A committee was appointed to audit the accounts of the Treasurer for the current year. A list of nominations of officers and other members of the council was adopted and ordered printed on the official ballot for the annual meeting in December. The treasurer of the society to be elected at the annual meeting was made curator of all property belonging to the society.

It was announced that the next summer meeting of the society will be held, in conjunction with that of the Mathematical Association of America, at Wellesley College.

The following papers were read at the October meeting:

H. S. Vandiver: "On Kummer's memoir of 1857 concerning Fermat's last theorem."

R. L. Borger: "On total differentiability."

Elizabeth LeStourgeon: "Minima of functions of lines."

Joseph Lipka: "Complete geometric characterization of the dynamical trajectories on a surface for any positional field of force."

Joseph Lipka: "Complete geometric characterization of the brachistrochrones, catenaries, and velocity curves on a surface."

Dunham Jackson: "On the convergence of certain polynomial approximations."

J. F. Ritt: "On algebraic functions which can be expressed in terms of radicals."

A. A. Bennett: "The Schwarz inequality for a given symmetrical convex region and given bilinear form."

Edward Kasner: "Determination of an Einstein gravitational field by means of the paths of free particles."

O. E. Glenn: "An algorism for differential invariant theory."

T. H. Gronwall: "Some inequalities in the theory of functions of a complex variable."

W. L. G. Williams: "Fundamental systems of formal modular semi-variants of the binary cubic."

The Southwestern Section will meet at the University of Nebraska on November 27. The annual meeting of the society will be held in New York, December 28–29. Its western meeting will be held at Chicago, December 29–30.

F. N. COLE,
Secretary

THE NATIONAL ACADEMY OF SCIENCES

THE program of the autumn meeting, held at Princeton University, was as follows:

TUESDAY, NOVEMBER 16

Morning Session

"Some approximate computations of x-ray wave-lengths," by W. Duane.

"The Peltier effect," by E. H. Hall.

"New facts bearing on the structure of the helium atom," by R. A. Millikan.

"The measurement of the ionizing potential of metallic surfaces," by R. A. Millikan.

"Further progress in the extreme ultra-violet," by R. A. Millikan.

"Fluorescence and chemical change in very intense light fields," R. W. Wood.

"A high speed photographic recording galvanometer for laboratory or technical use," by A. Trowbridge.

"Explosions of mixtures of coal gas and air under constant volume conditions," by A. Trowbridge.

Excursion to the Rockefeller Institute (department of animal pathology). Inspection of grounds and buildings, followed by luncheon as guests of the institute.

Afternoon Session

"A post-war use of war material," by L. O. Howard.

"The investigation of the flora of northern South America by the United States National Museum, the Gray Herbarium of Harvard University and the New York Botanical Garden," by N. L. Britton.

"The segregation and control of the light producing substances in organisms," by U. Dahlgren (introduced by E. G. Conklin).

"Rose Atoll, Samoa," by A. G. Mayor. (By title.)

"The tectonic conditions accompanying the intrusion of basic and ultrabasic igneous rocks," by W. N. Benson (introduced by Arthur L. Day.) (Read by title.)

"The oldest forest," by John M. Clarke.

"The evolution of the Proboscidea," by H. F. Osborn.

"The struggle between sun and ice for the past ten thousands of years," by Baron Gerhard De-Geer (introduced by H. F. Osborn).

"Unusual features of sedimentation in the Pennsylvanian strata, Bingham Canyon, Utah," by J. F. Kemp.

"Some geologic conclusions from geodetic data," by W. Bowie (introduced by A. O. Leuschner).

"Origin of the North and South American faunas," by W. B. Scott.

"The red layer, a contribution to the stratigraphy of the White River Oligocene," by W. J. Sinclair (introduced by W. B. Scott).

Reception by President and Mrs. Hibben for members of the Academy and guests, at "Prospect."

Lecture, complimentary to the citizens of Princeton. "Lessons of the Grand Canyon," by Professor W. M. Davis. Room 301, Palmer Laboratory. Following this a smoker was held at the Nassau Club.

WEDNESDAY, NOVEMBER 17

Morning Session

"Islands near the border of the coral seas," by W. M. Davis.

"Equipartition of energy," by E. B. Wilson.

"Einstein gravitational fields: orbits and light rays," by E. Kasner.

"Note on the Sobral eclipse photographs," by H. N. Russell.

"Knots and Riemann spaces," by J. W. Alexander (introduced by Oswald Veblen).

"The map coloring problem," by Philip Franklin (introduced by Oswald Veblen).

"Luminescence at high temperatures," by E. L. Nichols.

"The molecular state of water vapor," by J. Kendall (introduced by M. T. Bogert).

"The correlation of solubility, compound formation, ionization and electroaffinity in solution," by J. Kendall (introduced by M. T. Bogert).

"The Corbino effect in iron," by E. P. Adams (introduced by H. N. Russell).

"The application of a differential thermometer in ebullioscopy," by W. C. Menzies (introduced by Oswald Veblen).

"Occurrence of copper and zinc in marine animals and calcareous muds," by A. H. Philips (introduced by W. B. Scott).

"The adsorption of gases by metallic catalysts," by Hugh S. Taylor (introduced by Oswald Veblen).

"Experiments on electrical conduction in a hydrogen alloy," by Donald P. Smith (introduced by Oswald Veblen).

Afternoon Session

"Biological aspects of the process of infection," by Theobald Smith.

"Typhus fever; with description of the ætiology," by S. B. Wolbach (introduced by W. T. Councilman).

"Changes in the ear of the rat on the inception of hearing," by H. H. Donaldson.

"Experiments on the development of the gills in amphibians," by R. G. Harrison.

"An important period in the process of synapsis," by C. E. McClung.

"The sexual cycle of the larval bull-frog," by W. W. Swingle (introduced by E. G. Conklin).

"The basal metabolism of girls 12 to 17 years of age," by F. G. Benedict.

"Growth on diets poor in true fats," by L. B. Mendel. (By title.)

"The measurement of differences between races," by F. Boas. (By title.)

"Anthropology in the army," by C. B. Davenport.

"Further data on population growth," by Raymond Pearl. (By title.)

"The duration of constriction of blood vessels by epinephrin," by John Auer (introduced by S. J. Meltzer). (By title.)

"On a life-saving action of epinephrin—with a lantern slide demonstration," by S. J. Meltzer. (By title.)

"Nature of the effect of double vagotomy in rabbits," by Martha Wollstein (introduced by S. J. Meltzer). (By title.)

Subscription dinner of the academy. Proctor Hall, Graduate College.

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, DECEMBER 3, 1920

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

SOME FEATURES OF THE CHICAGO MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AND OF THE ASSOCIATED SOCIETIES, DECEMBER 27, 1920, TO JANUARY 1, 1921

THE Chicago meeting will be the seventy-third meeting of the association. It will be one of the larger and more comprehensive meetings, which are scheduled to be held every fourth year. It promises to be a greater meeting than any earlier one. Every American interested in science or education should attend if possible and should do all in his power to insure the success of the meeting for every branch of scientific and educational work.

Dr. L. O. Howard, Chief of the Bureau of Entomology, of the United States Department of Agriculture, is president-elect and will preside at the Chicago meeting. He has been permanent secretary of the association for twenty-two years, during which the membership of the organization has increased from 1,729 to nearly 12,000. The meetings held during his secretaryship have been increasingly successful and influential.

The address of the retiring president, to be given at the opening general session on the evening of December 27, will be by Dr. Simon Flexner, Director of the Rockefeller Institute for Medical Research.

There will be two other general sessions at the Chicago meeting planned to be of interest not only to all scientific workers and all members of the association but also to the general public. One of these general-interest sessions will be devoted to an illustrated lecture on High-Power Fluorescence and Phosphorescence, by Professor Robert W. Wood, of the physics department of the Johns Hopkins University. The other of these sessions will

be devoted to an illustrated lecture on The Volcanic Region of Katmai, Alaska, by Dr. Robert E. Griggs, of the Katmai Expeditions, National Geographic Society.

Thirty-seven associated societies, many of which are affiliated with the association, will meet with it at Chicago, and their sessions will generally be open to members of the association and the public. The retiring presidents of many of these societies will read presidential addresses. Also, each of the sections of the association, representing different fields of science, will hold its annual session, and the retiring vice-presidents for the sections will each present an address on some broad aspect of his own field. Also, many invitation papers will be read before the sections.

The geographical location of Chicago assures a large attendance and an exceptionally good representation of all branches of scientific endeavor. There have been two meetings of the American Association held at Chicago, one in August, 1868 (with an attendance of 259 and a total membership of 686), and the other at the end of 1907 (with an attendance of 725 and a total membership of 5,114).

For the advancement of science, for the progress of real education, and for the increase of knowledge and of the appreciation of knowledge—which is wisdom—among the people of America, it is especially desirable that this Chicago meeting should be well attended. This meeting will be the first of the larger four-year meetings since the close of the recent war and it will be the most centrally located of the four-year meetings for the next twelve years.[1] The war resulted in an increased appreciation of scientific and educational endeavor and it is of prime importance for the immediate future of American civilization that public interest in the work of the association be encouraged in all possible ways and with the least possible delay. A large and enthusiastic meeting of the association and of the societies associated with it will aid much in this direction, especially at the present time and at such a favorable location as Chicago.

It is therefore hoped that each member of the association and of the associated societies will make special effort to be present at Chicago, considering the matter not only from the ordinary personal standpoint but also with respect to its broader aspects that bear upon the most important features of the public welfare. To the individual, the question as to whether or not he will decide to attend the Chicago meeting is not only one regarding the assured benefit he will personally receive by attending; it also involves even the more important question of how much his presence would aid in making the meeting a success and in thus furthering the growth of well-founded civilization.

The local committee for the Chicago meeting has arranged for the association headquarters to be at the Congress Hotel and has cooperated with the secretaries of associated societies planning to meet with the association, so that headquarters hotels have been designated for these societies. Information regarding seventeen Chicago hotels is given in the announcement. The registration room (in the Reynolds Club, the University of Chicago, 57th St. and University Ave.) will be in telephonic connection with the hotels. Information regarding these, and also about other hotels and rooms in the vicinity of the university, may be had at the information desk in the registration room.

The general sessions of the association, and the sessions of the various sections and associated societies, will occur mainly in the buildings of the University of Chicago, under the auspices of which this meeting is to be held. Specific information regarding the meeting-places of the sections and societies will be given in the General program of the meeting, which will be available on the morning of December 27. Guide-signs and placards will be in evidence where needed, and inquiries may be made at the information desk in the registration room. The three general sessions of the association (evenings of

[1] The 1924–25 meeting will occur at Washington and that for 1928–29 will occur at New York; the 1932–33 meeting will be again at Chicago.

December 27, 28 and 29) will be held in Mandel Hall, entrance under the Tower, on 57th St. just west of University Ave.

There will be three general sessions of the association at Chicago, as follows:

1. Monday, December 27, 8 P.M., Mandel Hall, the University of Chicago. Opening addresses, followed by the address of the retiring president of the association, Dr. Simon Flexner, director of the laboratories of the Rockefeller Institute for Medical Research, New York City. Dr. Flexner will speak on "Twenty-five years of bacteriological research. A fragment of medical science." The presentation of Dr. Flexner's address will be followed by a general reception, to which are invited all members and friends of the American Association and of the associated societies, and all persons interested in science and education.

2. Tuesday, December 28, 8:15 P.M., Mandel Hall. Dr. Robert W. Wood, professor of physics in the Johns Hopkins University, will give a lecture, with demonstrations, on "High power phosphorescence and fluorescence." This lecture will involve recent important developments in the physics of light, presented in such a way as to be readily understood by every one. The experimental demonstrations will be especially interesting.

3. Wednesday, December 29, 8:15 P.M., Mandel Hall. Dr. Robert E. Griggs, of the Katmai Expeditions, National Geographical Society, will give an illustrated lecture on "The volcanic region of Katmai, Alaska." The illustrations will be by stereopticon slides and motion pictures and will be of fascinating interest.

The Wild-Flower Preservation Society will hold a reception to visiting scientists on Tuesday, December 28, at 8 P.M., in the Chicago Art Institute (Michigan Avenue near the Van Buren Street station of the Illinois Central Railway). Visitors will have opportunity to inspect an exhibit of flower portraits, special preparations, etc., which will then be installed in the Art Institute. Mrs. Charles L. Hutchinson is president of the society and Mrs. Charles Scribner Eaton is secretary.

The session programs of the associated societies and of the sections of the association (these programs being in the hands of the society and section secretaries) will be announced in the general program of the meeting, which will be available at the registration room (Reynolds Club, University Avenue and 57th Street) at 9 A.M. on Monday, December 27. Members of the association not attending the meeting, who desire to receive copies of the general program, will be supplied from the permanent secretary's Washington office after January 5, 1921 (as long as copies are available), if they make this request in a letter to the permanent secretary. The session programs, together with abstracts of papers, will be published in SCIENCE, the official publication of the association, during the early part of the new year.

Many joint meetings, dinners, smokers, etc., will be held at Chicago during the meeting, by the several associated societies and the sections of the association. These will be announced in the general program.

One of the important features of the association meetings has long been the opportunity offered for personal contacts among scientific and educational workers and their friends, but it is frequently somewhat difficult for one to find out whether a certain person is present or not and where he is staying if present. An attempt will be made at the Chicago meeting to remove the difficulty just mentioned, by maintaining a continuously corrected directory of all registrants. This directory will be conveniently placed in the registration room and may be readily consulted at any time. It will consist of a series of slips posted in a suitable place, arranged in a single alphabet by surnames. Each slip will show the name of the registrant, his home address and the name of the hotel, etc., where he is stopping for the meeting. Only a few minutes will elapse between the presentation of the registration card at the desk and the appearance of the corresponding slip in the visible directory. It is hoped that this arrangement will prove a source of satisfaction to those in attendance.

By a statement in the By-Laws of the association (Art. X., Sec. 1), "only members who have paid their dues shall enjoy the privileges of the meetings." The three general sessions will be the only occasions for any restriction of admission at the Chicago meeting. Members in good standing and associates for the meeting will enjoy all the privileges, including the general sessions. As set forth in the preceding section of this announcement, registered members and associates are to have the privilege of introducing guests for the general sessions. Members of associated societies who are not members or associates of the association are guests of the association for the three general sessions, but they do not have the privilege of introducing guests.

Students actually in attendance at the University of Chicago are to be guests of the association, in the same way as are members of associated societies. Others may receive the privilege of the general sessions by applying in the registration room, but it is hoped that the cooperative nature of the association will lead most persons of this group to become either members or associates. It is to be remembered that the work of the association requires funds and that the only available source of funds for this work is the dues paid by members and associates. The association does not wish to restrict the benefits of its meetings, but it must emphasize the fact that these are possible only through the loyal cooperative support of those who are interested in scientific advance and in the spread of knowledge.

Delegates to the Chicago meeting from scientific and educational institutions should promptly register as such. They will receive all the privileges of the meeting, as in the case of registered members and associates, except that of voting.

No special program of entertainment for visiting women is planned for the Chicago meeting. The local committee announces, however, that Ida Noyes Hall will be open to visiting women throughout the meeting, including the use of the dining and club facilities of this hall, which is perhaps the finest club for women that has ever been built. Visiting women will wish to inspect Ida Noyes Hall and its various arrangements. The building cost nearly half a million dollars. It will serve as a meeting-place and resting place for women during the meeting, better than has ever been enjoyed at any previous meeting of the association.

Dining-room service will be maintained throughout the meeting, at the University of Chicago Commons and at Ida Noyes Hall.

Persons attending the Chicago meeting may have mail, etc., addressed to them in the care of the American Association for the Advancement of Science, Registration Office, Reynolds Club, the University of Chicago, Chicago, Ill. They should call at the registration room daily, to inspect the personal bulletin, which will be conveniently located for quick inspection. If a person's name appears on this bulletin, it means that he should enquire at the proper desk for mail, etc. At the close of the meeting, or upon leaving, those in attendance are urged to leave a forwarding address for mail, etc. If this is not done, letters, etc., that are not delivered must be taken to Washington and resent from there, to the addresses shown in the files of the permanent secretary's office.

It has been impossible to secure any reduction in railroad rates for those attending the Chicago meeting. This matter is receiving serious attention and it is hoped that arrangements may be made by which reduced rates may be granted to the association for future years.

Members of the association and of associated societies who present papers at the Chicago meeting should come provided with abstracts of their papers, clearly and popularly presented, for the use of the Chicago press. All such material is to be given out through the publicity office of the local committee which will be in charge of Mr. Gilbert A. Bliss, of the local committee. It is hoped that all those in attendance will take an interest in this aspect of the meeting and that they will cooperate with Mr. Bliss, to the end that a suitable publicity may be obtained. This is a very

important feature in the work for which the association exists.

Those in attendance at the meeting may obtain information of all sorts by applying at the information desk in the registration room. Before the meeting, information may be obtained from the secretaries of the sections or of the associated societies (regarding programs, etc.), from the chairman of the local committee, Professor J. Paul Goode, of the University of Chicago regarding local arrangements, or from the permanent secretary's office in Washington regarding general association affairs.

BURTON E. LIVINGSTON,
Permanent Secretary
SMITHSONIAN INSTITUTION,
WASHINGTON, D. C.

A MORE NEARLY RATIONAL SYSTEM OF UNITS

SYSTEMS of units for physical magnitudes are designed to permit arithmetical calculations on the basis of known physical laws, and the test of the efficiency of any system is the extent to which it facilitates such computations. There are two ways, in particular, in which this can be accomplished: first, by relating the units of any one magnitude in a manner consistent with the system of arithmetic in use; with a decimal arithmetic this requires that the ratio of such units be a power of 10, *e. g.*, the erg and the joule; second, by so relating the units of different "dimensions" as to prevent the appearance of arbitrary and irrational factors in the equations expressing the fundamental laws of natural science, *e. g.*, the "gas law" should take the form "pressure = concentration × temperature" ($P = CT$) rather than "pressure is proportional to concentration × temperature" ($P = CRT$). The failure of the "English" system of weights and measures to meet these requirements is a matter of common knowledge, but it seems worth while to point out how little superior in these respects is the present "metric" system.

[1] Forty-first Contribution from the Color Laboratory of the Bureau of Chemistry, Washington, D. C.

The common basis of both these systems of physical and chemical units comprises: (1) the decimal arithmetic, (2) the mean solar second and (3) the table of atomic weights based on O = 16. It is not intended here to discuss these fundamentals, beyond pointing out that no one of them is entirely rational, and if they are retained it will be only because the difficulties in the way of superseding them outweigh the advantages of a change. The purpose of this paper is an inquiry whether on this common foundation there can be construed a system of units superior to either of the two now in common use.

1. Two systems of arithmetic with a base other than 10 are suggested by the methods of division of units in the case of "English" weights and measures (*a*) the twelve-system, illustrated by the dozen and gross and by the divisions of the foot and the pound Troy; (*b*) the two-system, illustrated by the divisions of the inch, the gallon and the pound avoirdupois. Both modes of division are used in coinage, though not at all consistently, (*a*) in the case of the shilling of twelve pence, (*b*) in the penny of four farthings and the distinctly non-decimal division of the dollar into quarters (and even into "bits" of 12½ cents). In a recent eulogy of the twelve-system (SCIENCE, N. S., 50, 239–242 (1919)), Dr. William Benjamin Smith says:

"This best of numerical systems is not the ten-system (which is recommended only by the fact that man has ten fingers and ten toes!) but the twelve-system, whose virtues are imbedded in the nature of number itself."

2. The humor of basing a decimal system of weights and measures on a unit of time obtained by dividing the mean solar day successively into 24, 60 and 60 parts, hardly needs emphasis. The mean solar day is the average interval between the passage of the sun across the meridian for any locality. The maximum difference between mean solar time and true solar time is 16 minutes (about November 1 of each year).

3. The change from the H = 1 system of atomic weights to the present O = 16 was made both because of the uncertainty of the H:O ratio and because the oxygen standard made more of the atomic weights approximate whole numbers. Re-

sults lately obtained on the atomic weights of the *isotopes* of lead and of neon indicate that one sixteenth of the atomic weight of oxygen is very near indeed to the unit mass of the Prout hypothesis, but it is highly improbable that it should be identical with it. (It would require that oxygen consist of one isotype only—or a still less probable balancing of heavy and light isotopes.)

The most flagrant case of irrationally related metric units is that of electrical quantity, for which four units, no two of which are commensurable, are in actual use. These four are (1) the electrochemical equivalent of electricity, or Faraday, (2) the coulomb, which is one tenth of the centimeter-gram-second electromagnetic unit, (3) the centimeter-gram-second electrostatic unit and (4) the "Heaviside" electrostatic unit, differing from the foregoing by the factor $1/\sqrt{4\pi}$, and used by Lorentz and others in electron theory calculations in order to give a simple form to the fundamental equations for the electromagnetic field. The ratio of the electromagnetic to the electrostatic unit is numerically the same as the velocity of light, hence a reconciliation is possible only in a system which makes the numerical velocity of light a power of 10. A unit of the Heaviside type is quite satisfactory for practical use, hence the adoption of such a unit would obviate the necessity of having one unit for theoretical and another for practical work. Finally, by a suitable selection of a unit of mass the electromagnetic and electrochemical units can be brought into harmony. (It should be noted that this involves giving up the use of water as a standard of density.) To summarize: it is possible—by making the numerical value of the velocity of light a power of 10, by suitably choosing the unit of mass, and by using the Heaviside definition of unit charge—to derive a single unit of electrical quantity suitable for all purposes.

Heat and temperature units are to be derived by purely dynamic definitions, without regard to the properties of the substance, water. Unit temperature is the temperature at which unit concentration of a "perfect gas" exerts unit pressure on the walls of its container; while the difference between the heat capacities of a mol of "perfect gas" at constant pressure and at constant volume is the unit of heat capacity and of entropy.

In Table I. are given the numerical factors which, in various combinations, are involved in conversion between the proposed units and those of the centimeter-gram-second system.

TABLE I

Symbol	Definition	Numerical Value[2]
4π	Ratio of area of sphere to square of radius	12,5664
10^p	Numerical value assigned in proposed system to the velocity of light and to the electrochemical equivalent[3]....	12.5664
c	Velocity of light in c.g.s. units	29,986,000,000. cm. per sec.
E	Electrochemical equivalent[3] in c.g.s. units	9,647.2 units per equivalent
R	Gas constant in c.g.s. units	83,150,000. ergs per mol per °C.
J	Value of the mean calorie in c.g.s. units	41,850,000. ergs per calorie

Tables II., III. and IV. give the ratios of the proposed units to those of the metric system—both algebraically in terms of the factors terms listed in Table I., and numerically. Numerical values are given only when the metric unit compared has a name in common use.

The names for multiples and submultiples of the fundamental units would be formed with the prefixes now in use in the metric system, *e. g.*, the kilo-unit of electric current and the mega-units of pressure and of temperature would probably be used more than the fundamental units; but, aside from the preference of one multiple or submultiple to another, the

[2] The values for the last four are taken from Kaye and Laby's tables.

[3] The quantity of electricity required to deposit electrolytically one equivalent of metal. E, the electricity in c.g.s. electromagnetic units per equivalent, is used instead of F, the number of coulombs per equivalent, to avoid mixing engineering and c.g.s. units.

TABLE II

Geometric, Kinematic and Mechanical

Unit of		In Terms of C.G.S. Unit		In Terms of Engineering Unit
Distance	$\frac{c}{10^9}$	29.986 cm.	$\frac{c}{10^{11}}$	0.29986 m.
Area	$\frac{c^2}{10^{18}}$	898.92 sq. cm.	$\frac{c^2}{10^{22}}$	0.089892 sq. m.
Volume	$\frac{c^3}{10^{27}}$	26951. c.c.	$\frac{c^3}{10^{33}}$	0.026951 cu. m.
Time	1	1 sec.	1	1 sec.
Velocity	$\frac{c}{10^9}$	29.986 cm. per sec.	$\frac{c}{10^{11}}$	0.29986 m. per sec.
Acceleration	$\frac{c}{10^9}$	29.986 cm. per sec.^{2}	$\frac{c}{10^{11}}$	0.29986 m. per sec.^{2}
Mass	$\frac{c}{4\pi E^2}$	25.636 g.	$\frac{c}{4\pi 10^3 E^2}$	0.025636 kg.
Concentration	$\frac{10^{30}}{4\pi c^2 E^2}$	0.9512 molal		
	$\frac{10^{27}}{4\pi c^2 E^2}$	0.0009512 g. per c.c.		
Momentum	$\frac{c^2}{4\pi 10^9 E^2}$	768.62 g. cm. per sec.	$\frac{c^2}{4\pi 10^{14} E^2}$	0.0076862 kg. m. per sec.
Force	$\frac{c^2}{4\pi 10^9 E^2}$	768.62 dyne	$\frac{c^2}{4\pi 10^{14} E^2}$	0.0076862 j. per m.
Pressure	$\frac{10^9}{4\pi E^2}$	0.85504 dyne per cm.^{2} (bar)	$\frac{10^8}{4\pi E^2}$	0.085504 j. per m.^{3}
Energy	$\frac{c^3}{4\pi 10^{18} E^2}$	23045. erg.	$\frac{c^3}{4\pi 10^{25} E^2}$	0.0023045 joule

units in engineering and scientific work would be identical.

The advantages to be gained are indicated by the following statement of some of the points of difference from both the English and the metric system. In the proposed system:

The fundamental unit of capacity (liquid measure) is the cube of the unit of length.

Astronomic units of distance now in use, "light second," "light hour," etc., are commensurable with the units proposed, the first being one *billion* times the fundamental unit of length.

Under "standard conditions" one mol of "perfect gas" occupies unit volume.

The difference between the specific heats of a "perfect gas" at constant pressure and at constant volume is 1.

Unit current in electrolysis deposits per second one *billionth* of an equivalent of metal.

The electrostatic capacity of an air condenser and the permeance of a magnetic air gap (or a magnetic circuit in air) are each one *billionth* of their respective "shape factors."[4]

The electric flux from a charge is equal to the charge, and the magnetic flux from a magnetic pole is equal to the pole strength.

The magnetomotive force, per turn, of a coil is equal to the current flowing through it.

The electromotive force, per turn, generated in a coil is equal to the rate of change of the flux within it.

The energy of an electric, or magnetic, field is equal to one half the product of the flux and, respectively, the electromotive or magnetomotive force.

[4] "Flow of Heat through Furnace Walls; the Shape Factor," Irving Langmuir, E. Q. Adams and G. S. Meikle, *Trans. Amer. Electrochem. Soc.*, 24, 53 (1914).

TABLE III

Electric and Magnetic

Unit of	In Terms of C.G.S. Unit		In Terms of Engineering Unit	
	Electrostatic	Electromagnetic		
Charge	$\frac{c^2}{4\pi 10^9 E}$	$\frac{c}{4\pi 10^9 E}$	$\frac{c}{4\pi 10^8 E}$	0.0024732 coulomb
Current	$\frac{c^2}{4\pi 10^9 E}$	$\frac{c}{4\pi 10^9 E}$	$\frac{c}{4\pi 10^8 E}$	0.0024732 ampere
Potential	$\frac{c}{10^9 E}$	$\frac{c^2}{10^8 E}$	$\frac{c^2}{10^{17} E}$	0.9318 volt
Capacity	$\frac{c}{4\pi}$	$\frac{1}{4\pi c}$	$\frac{10^9}{4\pi c}$	0.0026542 farad
Resistance	$\frac{4\pi}{c}$	$4\pi c$	$\frac{4\pi c}{10^9}$	376.74 ohms
Energy	$\frac{c^3}{4\pi 10^{18} E^2}$	$\frac{c^3}{4\pi 10^{18} E^2}$	$\frac{c^3}{4\pi 10^{25} E^2}$	0.0023045 joule
Flux	$\frac{c}{10^9 E}$	$\frac{c^3}{10^9 E} =$		93180000 gauss
Density	$\frac{10^9}{cE}$	$\frac{10^9}{E} =$		103660 maxwell
Magnetomotive force	$\frac{c^2}{10^9 E}$	$\frac{c}{10^9 E} =$		0.0031079 gilbert
Reluctance	c	$\frac{1}{c} =$		0.000000000033353 oersted
Energy	$\frac{c^3}{4\pi 10^{18} E^2}$	$\frac{c^3}{4\pi 10^{18} E^2} =$		23045 erg

TABLE IV

Thermal

Unit of	In Terms of Calorimetric Units		In Terms of C.G.S. Units	
Heat capacity	$\frac{cR}{4\pi E^2 J}$	50.934 calories per g. per ° C.	$\frac{cR}{4\pi E^2}$	2131600000. ergs per g. per ° C.
Entropy	$\frac{cR}{4\pi E^2 J}$	50.934 calories per g. per ° C.	$\frac{cR}{4\pi E^2}$	2131600000. ergs per g. per ° C.
Temperature	$\frac{c^3}{10^{18} R}$	0.000010811 degree	$\frac{c^3}{10^{18} R}$	0.000010811 degree
Energy	$\frac{c^3}{4\pi 10^{18} E^2 J}$	0.00055064 calorie	$\frac{c^3}{4\pi 10^{18} E^2}$	23045. erg

A few examples of the working of the system of units follow. It has been thought best not to attempt to coin names for the proposed units, hence the values will be given without designation unless a multiple or submultiple of the fundamental unit has been used, when the abbreviation of the appropriate Metric prefix will be added (μ, micro-; m, milli-; c, centi-; d, deci-; D, deka; H, hecto-; K, kilo-; M, mega-).

Find the capacity of a vat of length 10, width 5 and depth 4. Answer: $10 \times 5 \times 4 = 200$

Find the volume of a sphere of 1 light second radius. Answer:

$$\tfrac{4}{3}\pi(10^9)^3 = \tfrac{4}{3}\pi \times 10^{27}.$$

Find the molecular weight of a substance, a mass of 15 m of which occupies a volume of 12 m, at a temperature of 30 M and a pressure of 1.2 M. Answer:

$$\frac{15 \times 30}{12 \times 1.2} = 31.25.$$

Find the time required with an electric current of 10 K and a potential of 100 to heat unit mass of helium (atomic weight, 4) through a temperature interval of 10 M, at constant pressure. (The specific heat of a monatomic gas at constant *volume* is 3/2.) Answer:

$$\frac{\frac{1}{4} \times 10^7 \times (\frac{3}{2} + 1)}{10^4 \times 100} = 62.5 \text{ sce.}$$

Find the mass of copper (valence 2, at.wt. 63.57) that would be deposited by a current of 10 K in 1,000 sec. Answer:

$$\frac{63.57 \times 10^4 \times 1{,}000}{2 \times 10^9} = 0.318.$$

Find the capacity of a condenser with 100 sheets of dielectric (of dielectric constant 2) each of unit area and thickness 0.01. Answer:

$$\frac{100 \times 1 \times 2}{10^9 \times 0.01} = 2 \times 10^{-5} = 20\mu.$$

Find the inductance of a coil of 100 turns wound on a closed core of iron of permeability 1,000, of cross section 0.2 × 0.2 and length of magnetic circuit 4. Answer:

$$\frac{\overline{100}^2 \times 1{,}000 \times .2 \times .2}{10^9 \times 4} = 10^{-4}.$$

Find the magnetic energy of the core when a current of 1 K is passing through the coil. Answer:

$$\tfrac{1}{2} \times (10^3)^2 \times 10^{-4} = 50.$$

In conclusion, it should be noted that the foregoing is primarily a description of a method of deriving a system of units, and that a system of substantially equal convenience could be devised with an other than decimal arithmetic, a different unit of time or another basis of atomic weights.

SUMMARY

1. On the common foundation of the English and metric systems of units there can be constructed a system superior to either.

2. Its bases are (1) the mean solar second, (2) a length of 29.986 cm. and (3) a mass of 25.636 g.

3. Tables of the relation of the various units in this system to the corresponding metric units are given.

4. A single set of units serves for both engineering and scientific purposes.

ELLIOT Q. ADAMS
BUREAU OF CHEMISTRY,
WASHINGTON, D. C.

PALEONTOLOGY AND PRAGMATISM

Two recent publications of the United States National Museum admirably illustrate a phase of the scientific activities of the government to which I have long thought of calling attention, since they are accomplished without noise or press notices and are of immense value to the people as a whole in addition to their intrinsic scientific worth.

The publications to which I refer are North American Early Tertiary Bryozoa, by Canu and Bassler, constituting Bulletin 106, and Contributions to the Geology and Paleontology of the Canal Zone, by T. Wayland Vaughan and associates, constituting Bulletin 103. More particularly I wish to refer to the work of Canu and Bassler on the Bryozoa, Joseph A. Cushman on the Foraminifera, Marshall A. Howe on the calcareous algæ, and T. Wayland Vaughan on the corals.

These are all groups of organisms whose habits are exceedingly interesting and whose forms are often highly artistic, but none of which furnish food for commercial fishes or humanity, or are objects of trade,[1] or yield any gums, wax, gems, or minerals that might make them seemingly worth while to the man in the street.

The Bryozoa are inconspicuous colonial animals, some of them with a beauty all their own, but seldom appreciated since they require magnification in order to be seen to advantage. Some are usually included in amateur collections of so-called sea weeds, but to the average person a bryozoan is as unknown as a native of Mars. The recently installed sea

[1] The red coral of commerce and its imitations are exceptions, but these are European and not American products and do not affect the force of the statement.

bottom exhibit in colored glass at the American Museum of Natural History will undoubtedly call the attention of a considerable circle to the wonderful habits and esthetic forms of these tiny animals. That the monograph by Canu and Bassler is a splendid contribution to paleozoology goes without saying—the names of the authors are a guarantee of that—what I wish to emphasize is the utilitarian value of such studies.

The Bryozoa belong to a geologically very old phylum, the vast majority secrete a calcareous skeleton, and since they are so plentiful and so tiny they are preserved as fossils in great abundance at very many geological horizons. They are thus admirably adapted to become medals of creation, and highly satisfactory time markers for geologists. They well illustrate the old aphorism of the importance of the insignificant, since while infinitely varied in detail, their specific limits are usually sharp and their range in time is not too great to enable them to be used with great precision in the determination of the age of geological formations and their correlation over wide areas. Their value has long been recognized in the older geological formations of the Paleozoic and Mesozoic, but in this country at least, their usefulness in delimiting the later formations, has hitherto remained unevaluated.

Geologic correlation may seem remote from the affairs of the workaday world and yet upon its successful consummation rests not only the understanding of the local and general relations underground that are the basis of all exploitation of artesian waters, oil, and other mineral resources of the earth, but it is of prime importance in determining the places or origin and the paths of migration of the life of bygone days. The early Tertiary bryozoa of the Atlantic Coastal Plain not only serve to substantiate the evidence derived from other classes of fossils, but may be expected to eventually help determine whether the past floodings of this region were simultaneous with similar events in the Old World and hence caused by changes in sea level or whether these were due to regional changes in the attitude and elevation or depression of the land.

National Museum Bulletin 103 contains elevent different papers upon the geology and paleontology of the Canal Zone and much additional information with regard to the Antilles, especially with respect to the corals. In fact, if the Mollusca could have been included, it would serve as a complete manual of the geology and paleontology of that region.

A knowledge of calcareous algæ, either recent or fossil, is confined to a few specialists. Their fossil remains have never been much used in stratigraphic geology, because, like the bryozoa, diatoms and foraminifera, sufficient intelligence had not been focused upon them to determine their value as indicators of horizons, past events, or past physical conditions. It is only recently that their importance in the formation of magnesium carbonate and the great part they take in the formation of the so-called coral reefs of both the past and the present, has been understood.

The Foraminifera constitute a group of organisms that are exceedingly abundant in existing seas, and useful in a variety of ways in studies of plankton and experimental evolution. They belong to the great and primitive group of the Protozoa, or unicellular animals, and since, unlike so many of their congeners, they early acquired a siliceous or calcereous skeleton they have been preserved in ever increasing abundance in certain marine formations from the Silurian down to the present.

Although they have been utilized to some extent abroad, particularly in the recognition of zones in the nummulitic limestones of the Mediterranean regions, they have attracted but few students in this country, and have been rather generally regarded as lacking in chronologic value. This reputation was largely the result of the specific limits as conceived by English students such as Parker, Jones and Brady, who published large standard works in which single species showed most astonishing ranges of millions of years. Naturally forms that live on unchanged for eons

may safely be ignored in trying to determine the age and succession of the rocks.

It may be doubted, however, if any class of organisms do not have an interesting and important story to tell provided we learn their language. This has proven to be the case with our American foraminifera at the hands of Cushman. Since forams are generally small and abundant when present at all they stand a much better chance of preservation in both compact limestones and coarse sandy marls than do the tests of higher and larger marine organisms. They have been particularly useful in tracing the Tertiary geological zones around the equatorial belt of the world. In Panama, around the borders and on the islands of the Spanish Main, as well as in our own southern coastal plain, the Foraminifera have proven to be often the only, and always among the most satisfactory types of fossils. Widely distributed in the seaways, rapidly mutating into recognizable differentials, they have been one of the keys to our understanding of the history of equatorial America.

They, like the Bryozoa, are generally small enough to be present in well samples where larger forms are not encountered or are largely smashed beyond recognition by the drills. They have lately been shown to be of profound significance in the location of the oil sands by means of a study of well cuttings in the Texas oil fields. They are almost the only fossils in the thick series of calcareous clays that overlie the oil sands in the Tampico district, and in this last region alone will eventually contribute more in dollars and cents to the wealth of the world than all of the issues of the Congressional Record that have ever been printed.

Probably the laymen requires no introduction to corals. All boys can probably be divided into two classes, at least such was once the case—those who avowed that they were going to be locomotive engineers when they grew up, and those who longed to explore a coral reef or live on a South Pacific coral atoll. Any one who has never experienced the thrill that comes from contemplating the profusion of surging life in and around a coral reef, or does not know the fascinating beauty of even the dead skeletons of coral life would do well to read the popular illustrated account by Vaughan in the last annual report of the Smithsonian Institution.

Corals are all small marine animals, but many of them dwell in colonies, notably the so-called stone corals, and secrete the calcareous skeletons familiarly known as corals. Like the Bryozoa, corals are sedentary except for the short period when they have a free-swimming larval fling as it were. Their ancestors go back as far as the fossil records go, and they have never suffered the obliquity as horizon markers that has at times attached to the Bryozoa and Foraminifera.

Reef corals require definite temperatures and environmental conditions in order to flourish. hence they are useful in retrospective prophecy. Geologically they are especially important during later geological times in Mediterranean regions—in the south of Europe, the Antilles, and the balance of equatorial America. Their contribution to our understanding of the relations and geological history of the Antilles is probably not equalled and certainly not exceeded by any other group of organisms.

In conclusion to cite but a single pragmatic instance of the ultimate commercial value of these monographic paleontologic studies that are published by the National Museum—the exploration for oil in central and northern South America, and the successful interpretation of structure that is the key to commercial success or failure in the far off *tierra caliente* of Colombia or Venezuela, rests very largely on the application of the results of the unostentatious and unadvertised paleontologic studies.

EDWARD W. BERRY
JOHNS HOPKINS UNIVERSITY

SCIENTIFIC EVENTS

A NEW OBSERVATORY IN CLEVELAND

CASE School of Applied Science, Cleveland, Ohio, dedicated a new observatory on Columbus Day, October 12, 1920. It is to be known

as the Warner and Swazey Observatory, in honor of the donors, members of the noted firm that have made so many of the largest and best telescopes in this country. Mr. Warner is a trustee of Case School of Applied Science, and both men have long taken an active interest in the work of the school. They secured the site on the brow of a hill overlooking a residential section of East Cleveland, about two miles from the campus, but easily accessible, and erected on it a handsome brick structure filled with all the necessary equipment to carry on college instruction in astronomy. The gift to Case is the most noteworthy addition to astronomical equipment in this section of the country, and especially significant because it is in the home city of the men whose name it will bear.

The observatory is L-shaped, with the tower and dome at the angle. One wing contains two astronomical transits, and a zenith telescope, all from the Warner and Swazey factory. The other wing contains a constant-temperature clock room, provided with two Riefler clocks, and a library room, suitable for class use as well, housing the school's collection of astronomical books. The tower will accommodate a small class where the ten-inch telescope is mounted. The lens was ground by John Brashear, of Pittsburgh. The tube is fitted with every device known to the expert makers to increase its usefulness. In the basement are living apartments for a caretaker, a storeroom, a battery room, and a dark room for photographic purposes.

At the dedicatory exercises, which were held outdoors on the grounds, both Mr. Swazey and Mr. Warner spoke, the former relating some of the firm's experiences in the making and improving of astronomical instruments, and the latter referring especially to the instrument presented to Case, and making the formal presentation. President Charles S. Howe accepted the gift on behalf of the trustees. The main address of the occasion was given by Director W. W. Campbell, of the Lick Observatory of the University of California, on the subject, "The Daily Influence of Astronomy." Professor D. T. Wilson, professor of astronomy at Case, outlined the work done at the school in astronomy, and the services he hoped the school would be able to render the community by means of this splendid observatory.

K. O. THOMPSON

A SURVEY OF FOREST RESEARCH

"NORTH American Forest Research" published as Vol. 1, Part 4, No. 4, of the *Bulletin of the National Research Council*, Washington, D. C., is a summary of the investigative projects in forestry and allied subjects. It covers the work carried on in 1919–1920 by national, state, and provincial governments, schools of forestry, scientific schools and private interests in Canada, Newfoundland and the United States. The work is a compilation by the committee on American forest research, of the society of American Foresters. It is the first and only authoritative and complete outline of research work in forestry devoted to increasing the knowledge of the best means of producing and utilizing one of the greatest natural resources of the North American continent.

Agricultural research, as exemplified by the agricultural experiment stations, has proved its practical value. Forest research attempts to do for forest production what agricultural research has done for agricultural production.

The bulletin describes the investigative work that is being done in four main fields. (1) Utilization of forest products; (2) Proper handling of the forest and its perpetuation; (3) Proper handling of the range within or adjoining forests; (4) Forest economics, or the relation of the forests and their products to the economic life of the continent.

The survey is said to contain brief descriptions of studies being carried on for practically every important forest region, type and tree and in every province and state in which the forests are an important economic factor in North America.

A SCORE FOR HEALTH ACTIVITIES

THE New York State Department of Health has prepared an activities score for cities with

a population of from 25,000 to 175,000 inhabitants. Of a possible 1,000 points for perfect, adequate public health nursing service counts 75; other follow-up social service 10; adequate dispensary or clinic service 70; hospital facilities for the communicable diseases 45; a day nursery 10; Little Mothers' League 10; good newspaper publicity regarding health matters 50; and a physician in charge of the infant welfare station 15. This gives a total of 285 points for activities in which the nurse is directly concerned. In general the score provides the following distribution of credit:

Communicable disease control:	
Tuberculosis, perfect score	60
Venereal diseases, perfect score	70
Other communicable diseases, perfect score.	80
Adequate laboratory facilities and use of same	100
Infant and maternal welfare	90
Milk and food inspection	100
Water supply	100
Sewage, garbage and manure disposal	40
Record keeping	85
Public health education	120
An appropriation of at least 50 cents per capita for health protection	100
Effective enforcement of regulations governing barber shops, common towels, drinking and eating utensils	20
Unusually meritorious public health work along either new or old lines	35
Total	1,000

COUNCIL MEETING OF THE ILLINOIS STATE ACADEMY OF SCIENCE

AT the call of President Cowles a meeting of the council was held at the University Club, Chicago, on September 28. There were present President Cowles, retiring President Ward, Vice-president Knipp, Treasurer Watermann and Librarian Crook.

The first question taken up was how best to meet the great misfortune which had befallen the academy in the death of Secretary Pricer. It was voted that the librarian continue until the next meeting to serve as secretary, as he had been doing at the request of the president since the death of Secretary Pricer. With some misgivings as to the wisdom of such appointment the librarian consented.

In conformity with action at the Danville meeting the following legislative committee was appointed: H. C. Cowles, Chicago, chairman; William Barnes, Decatur; E. W. Payne, Springfield; R. M. Barnes, Lacon; Geo. Langford, Joliet.

It was voted that the fiscal year of the academy begin with the calendar year and that dues be payable on the December 1st preceding, to accord with arrangements with the A. A. A. S. The secretary was instructed to mail the three volumes of *Transactions* which are to appear shortly, to paid-up members only.

It was decided to hold the annual meeting for 1921 at Carbondale some time in the spring with the hope of having a field day and the president was requested to begin arrangements for such meeting. The president was requested to appoint chairmen for the various sections which it might seem advisable to form at the coming meeting. The treasurer presented matters concerning various classes of members and the relation between the State Academy and the A. A. A. S. It was suggested that he publish a list of members whose address is unknown, in hope that some member can supply the information wanted.

The following committee was appointed to continue the work of interesting high school science clubs, other science clubs, boards of education, teachers, etc. in the work of the academy and to suggest to them the desirability of sending delegates to academy meetings: Charles T. Knipp, Chairman, Urbana; W. G. Watermann, Evanston; R. H. Linkins, Normal; H. S. Pepoon, Chicago.

A. R. CROOK,
Acting Secretary

THE ENGINEERING FOUNDATION

AN anonymous gift of $200,000 toward a five-million-dollar fund for the promotion of research in science and in engineering is announced by Engineering Foundation at its headquarters in the Engineering Societies Building, New York City. This contribution

brings the foundation's fund to $500,000. It is the aim of the foundation to obtain one million dollars by January first.

Engineering Foundation was organized to care for the gifts aggregating $300,000 of Ambrose Swasey, of Cleveland, Ohio, the income from these gifts being devoted to research. Since its organization as a trust fund in 1914, the funds of the foundation have been used to aid the National Research Council and others in performing research directly connected with engineering. Mr. Swasey's gifts were made to United Engineering Society as a nucleus of a large endowment "for the furtherance of research in science and in engineering, or for the advancement in any other manner of the profession of engineering and the good of mankind."

The Engineering Foundation is administered by the engineering foundation board composed of members from the American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, American Society of Mechanical Engineers, and American Institute of Electrical Engineers and members at large. The board is a department of United Engineering Society. It is the instrumentality of the founder societies named for the stimulation, direction and support of research.

The officers of Engineering Foundation are Charles F. Rand, chairman; Edward Dean Adams, first vice-chairman; Frank B. Jewett, second vice-chairman; Joseph Struthers, treasurer; and Alfred D. Flinn, secretary. The executive committee is composed of Charles F. Rand, chairman; Edward Dean Adams, George B. Pegram, Frank B. Jewett and H. Hobert Porter.

A statement issued by the foundation says:

Potential benefits for the whole nation are very great, but these benefits can not be gained without expenditure of effort and materials. Research workers must be supported. Equipment, materials, working places and traveling facilities must be provided. Since the benefits accrue to the profession, the industries and the public in general, support in large measure should come from general funds, such as those provided by endowments.

Engineering Foundation seeks to build up its endowment to dimensions worthy of the engineering profession. Engineers connected with industrial and financial organizations having great resources can aid by convincing proper officials of corporations that the continued prosperity of our industries depends upon continued progress of research. Since the commercial and industrial establishments of the country reap the larger proportions of the financial profits arising from scientific and technological work, these establishments should contribute liberally to the support of research.

There are many problems relating to the materials and forces of engineering on which further knowledge is needed. Progress will be made approximately in proportion to the funds made available. But there are other kinds of problems which concern the engineer. No longer may one declare, as did Professor J. H. Johnson a generation ago, that "Engineering differs from all other learned professions in this, that its learning has to do only with the inanimate world, the world of dead matter and force."

Many acute social and economic questions of our day need the dispassionate, impartial, patient study of scientists and technologists. To these questions must now be applied the scientific method of collecting facts by thorough study, and the engineer's capacity for planning and performing, instead of ill-considered "reforms."

Occasionally experimental work is undertaken in accordance with a well-conceived plan as a necessary or desirable adjunct to the main operation. In such cases the exigencies of the main operation sooner or later interrupt the experimental work; or the men who have it in hand leave the force; or the information is gained but never written up; or the statement is buried in some report of limited circulation; or greater familiarity with research methods and a broader conception of the problem could, with small additional expense, have secured much more valuable results and have made them more generally useful.

These services and many others could be performed by Engineering Foundation, if adequate funds could be placed at its disposal. The Foundation does not plan to build laboratories and conduct research work directly, but rather to stimulate, coordinate and support research work in existing scientific and industrial laboratories, cooperating, in so far as possible, with the National Research Council.

SCIENTIFIC NOTES AND NEWS

AT the annual meeting of the Royal Society on November 30, Dr. C. S. Sherrington, Waynflete professor of physiology at the University of Oxford, was elected president to succeed Sir Joseph Thomson.

DR. E. H. GRIFFITHS has been elected general treasurer of the British Association in succession to the late Professor John Perry.

THE Weldon medal has been conferred by the University of Oxford upon Dr. J. Arthur Harris, of the Station for Experimental Evolution of the Carnegie Institution of Washington, in recognition of his work in biometry. The Weldon Medal, accompanied by a monetary prize of about £90 may be awarded every three years ". . . without regard to nationality, sex, or membership of any University, to the person who, in the judgment of the electors, has, in the six years next preceding the date of the award, published the most noteworthy contribution to biometric science," in the field of zoology, botany, anthropology, sociology, psychology or medical science.

THE King of Italy has conferred upon J. E. Zanetti, assistant professor of chemistry in Columbia University, the order of the crown with the rank of officer, for services rendered during the war as lieutenant-colonel in the Chemical Warfare Service. He has also received from the French government the legion of honor and from the British government the distinguished service order.

PROFESSOR ALBERT P. WILLS, of the department of physics in Columbia University, and Dr. Frederick Barry, formerly instructor in chemistry, have been awarded the Ernest Kempton Adams research fellowship by Columbia University. This fellowship was founded in 1905 by Edward Dean Adams in memory of his son Ernest Kempton Adams, E.E. '97, A.M. '98. The provision of the fellowship is that its incumbent "shall prosecute researches either in Columbia University or elsewhere, in the physical sciences, in psychology or in their practical applications."

DEAN P. H. ROLFS, for fifteen years director of the Florida Agricultural Experiment Station and for the past six years dean of the Agricultural College, has been granted leave of absence to locate, establish and conduct an agricultural institution for the state of Minas Geraes, Brazil. His address after January 1 will be at Bello Horizonte, Minas Geraes, Brazil. The president of that state desires to have a full corps of scientific workers appointed from the United States.

IT is stated in *Nature* that the following have been elected officers of the Cambridge Philosophical Society for the session 1920–1921: *President,* Professor Seward; *Vice-presidents,* Sir E. Rutherford, Mr. C. T. R. Wilson and Dr. E. H. Griffiths; *Treasurer,* Professor Hobson; *Secretaries,* Mr. H. H. Brindley, Professor Baker and Mr. F. W. Aston; *New Members of the Council,* Professor Marr, Mr. C. T. Heycock, Mr. H. Lamb, Professor Hopkins, Dr. Bennett and Dr. Hartridge.

FIVE university lectures on "The theory of relativity" are being given at Cornell University by Dr. L. Silberstein, of the research laboratory of the Eastman Company, of Rochester. Dr. Silberstein suggested that a preliminary lecture beginning with the experimental basis of the theory of relativity would be helpful, and such an introductory lecture was given by Professors Floyd K. Richtmyer and E. H. Kennard, of the physics department of the university.

C. E. KENNETH MEES, director of the research laboratories, Eastman Kodak Company, delivered a lecture on December 2, before the Franklin Institute, Philadelphia, on "The structure of photographic images."

ELMER D. MERRILL, director of the Philippine Bureau of Science, delivered on November 18, an address on "Land and nature in the Philippines," before the Washington Academy of Sciences.

PROFESSOR J. STIEGLITZ, of the University of Chicago, gave three lectures on the Mayo Foundation at Rochester, Minnesota, on November 3, 4, and 5, on "Chemistry and

medicine" and "The electric theory of combustion."

DR. J. PAUL GOODE, professor of geography in the University of Chicago, gave an address before the general staff of the College of the Army at Washington, D. C., on November 12, on "The geographic and economic foundations of the world war."

PROFESSOR HAROLD HIBBERT, of Yale University, lectured before the Stamford Chemical Society on "The constitution of cellulose" on the evening of October 25.

DR. FREDERICK H. GETMAN lectured before the Rhode Island State College on November 18 and before the Rhode Island Section of the American Chemical Society at Providence, on November 19, taking as his subject "The relation between absorption and spectra and chemical constitution."

BARON GERARD DEGEER, professor of geology at the University of Stockholm, delivered two lectures at the University of Michigan on November 12. The topic of the lectures was "An autographic record of climate for the last ten thousands of years," in which lectures the methods of work and the applications to Sweden and America were discussed.

THE annual Huxley memorial lecture of the Royal Anthropological Institute was delivered by Dr. A. C. Haddon, in the lecture-room of the Royal Society on November 23, on "Migrations of Cultures in British New Guinea."

A MONUMENT has been erected at Castera-Verduzan, Gers, France, to the memory of the celebrated French surgeon and pathologist, Lannelongue, who died in 1911.

WE learn from *Nature* that the council of the British Association has agreed to the formation of a separate section of psychology, as recommended by the sections of physiology and educational science at Cardiff, and approved by the general committee. Consideration of the number and scope of the various sections is to be referred to a special committee. It has been decided to invite national Associations for the Advancement of Science to send representatives to annual meetings of the British Association in future.

THE second International Congress of Comparative Pathology will be held at Rome in April, 1921. An organizing committee has been established under the presidency of Professor Perroncito, composed of Professors Ascoli, Golgi, Grassi, Lustig, Marchiafava, Paterno, Raffaele, Sanarelli, and Colonel Bertoletti. Among the subjects to be discussed are influenza in man and animals, foot-and-mouth disease, recent researches in sarcoma and carcinoma, rabies and antirabic vaccination, piroplasmosis, acari and scabies in man and animals, and phylloxera.

THE Upsilon Sigma Chapter of the Chi Phi medical fraternity has been installed at Columbia University. The installation ceremonies and a dinner of the fraternity were held recently at the Hotel Netherland in New York.

SINCE October the Dominion Observatory, Ottawa, has been recording on the chronograph the Arlington and Annapolis wireless time signals, together with the Observatory Riefler clock.

THE Smithsonian Institution, of which her father, Joseph Henry, was secretary for many years, is to be the ultimate beneficiary of the estate of Caroline Henry, according to the terms of her will, which has been filed for probate. An immediate bequest of $1,000 is made to the institution, together with several other bequests. The net income from the remaining estate is to be distributed among several beneficiaries upon whose death the estate is to go to the Smithsonian Institution.

Nature writes "the council of the British Association has recently had before it the suggestion made by Professor Herdman in his presidential address at Cardiff for a new *Challenger* expedition for the exploration of the great oceans of the globe with modern instruments and methods. It will be remembered that this proposal received the support of all the sections of the association by formal resolution, and the council was asked to appoint

a committee to take the necessary steps to urge its need upon the government and the nation. This committee has now been appointed, and the scientific world will follow its activities and their result with close attention. An oceanographical expedition along the lines contemplated, and equipped with the instruments which modern science can provide, would lead to a great increase of knowledge both for scientific study and for profitable development, and no nation could carry it out more appropriately than Great Britain in cooperation with our overseas Dominions. There will be an eclipse of the sun in September, 1922, with the line of totality crossing the Maldive Islands, and the expedition could very well include an astronomical party to observe it. It is believed that the Admirality is favorably disposed towards the scheme, and every scientific man hopes that the necessary support will be forthcoming to carry out the enterprise on a scale worthy of the British empire."

THE annual meeting of the British Medical Association will be held on July 19, and the scientific sections will meet on July 20, 21 and 22. The annual meeting in 1922 will be held in Glasgow, and the council has now decided to recommend to the Representative Body that the annual meeting in 1923 shall be held at Portsmouth, in response to an invitation of the Portsmouth Division.

THE Rockefeller Foundation announces the gift to the State of Louisiana of the Grand Chenier Wild Life Refuge, comprising about 85,000 acres, in Cameron and Vermillion laboratories, equipment, methods, publications. parishes. The tract was purchased from individual holders by the foundation in 1914, in order to preserve the wild life of the country and has since been under the supervision of the Department of Conservation of the State. A condition of the gift is that the tract shall remain as a perpetual wild-life preserve.

EDUCATIONAL NOTES AND NEWS

THE two weeks' campaign for a $5,000,000 endowment fund for McGill University ended with the collection of $6,321,511.

DR. JOHN GABBERT BOWMAN, president of the University of Iowa from 1911 to 1914 has been elected chancellor of the University of Pittsburgh to succeed Dr. Samuel Black McCormick.

THE Cornell University board of trustees at its meeting on November 13, assigned professors to eight professorships which were established last June commemorating the service of Cornellians in the war. The assignments in science are Professor Ernest Merritt (physics), in arts and sciences; Professors S. S. Garrett and E. W. Schroder, in engineering; Professor W. D. Bancroft (physical chemistry), in the graduate school; Professor Sutherland Simpson (physiology) in the Ithaca division of the medical college.

AMONG recent appointments to the faculty of the college of arts and sciences of Tulane University are the following: Dr. D. S. Elliott, recently head of the department of physics in the Georgia Institute of Technology, has been elected to the professorship of physics. Dr. S. A. Mahood, chemist of the Forest Products Laboratory of the University of Wisconsin, has been elected to an associate professorship in chemistry. Dr. Herbert E. Buchanan, professor of mathematics in the University of Tennessee, has been elected to the chair of mathematics.

MR. J. W. BARTON, recently fellow in psychology in the University of Minnesota and formerly a member of the faculty of the University of Utah, has been elected associate professor of psychology in the school of education of the University of Wyoming.

R. J. GARBER, assistant professor of plant breeding at the University of Minnesota, has been appointed associate professor of agronomy and associate agronomist in the West Virginia University and Station.

DISCUSSION AND CORRESPONDENCE

RECEDENT LAKE SHORES OF THE CRETACEOUS

LAST year while cycad hunting in the southern Black Hills, Mr. E. F. Arnold called my

attention to a remarkable reef of huge concretions in the Lakota of "Driftwood Cañon" several miles northerly through the "rim" from the Burlington dam. The forms simulated huge more or less globular cycads three or four feet through, and displayed much coarse radial structure, with more or less granular siliceous or even sandy, to partly limy texture. As an illustration of these forms, Plate 21 in "Lakes of North America," by I. C. Russell, showing an old lake Lahontan shore, would all but serve. Though knowing the Lakota of the Black Hills so widely, and never having noted anything similar before, I looked on the Driftwood reef as belonging to the domain of the purely inorganic.

Now, however, this phenomenon has come up in a much more tangible form. Early this year Mr. Jesse Simmons, a geologist of the Midwest Refining Company wrote me that he had observed innumerable cycad-like masses in the Lakota [Cloverly] of the Como anticline, about sixteen miles easterly from Medicine Bow, Wyoming. On reaching this point last August I found very striking conditions indeed. There is, fairly speaking, a reef of the calcareous concretionary forms, or tufaceous heads of finely radiate structure. This lies near the top of a sandy to conglomeratic rim 80 or more feet thick resting on the broadly exposed [Como of Marsh] Morrison. The reef stratum itself marks a change in sedimentation, being sandy, to shaly or slightly limy, with the concretions very definitely in the lower portion and varying from quite globular types one to two feet in diameter up to much larger more irregular shaped masses. While immediately within the reef occur numerous smoothed quartz pebbles from small up to several pounds weight. Of these many are simply smoothed or with a ground-glass surface, but many others are polished, and of the type known as "Dreikanter" with the desert "patina." Such are like, though in no way to be confused with the *gastroliths* of the Como or other Dinosaurians.

As showing in a most curious manner the course of events on this reef one of the concretions, a subspherical example one and one half feet through which I packed and sent back to Yale, contains imbedded well toward its center one of the highly smoothed pebbles a half pound in weight. All round this pebble the radiate concretionary structure runs as uninterruptedly, the same as if no pebble were present. Evidently when these siliceous pebbles containing traces of fossils of some earlier geologic period were being smoothed by wind or wave or both, and when the masses of calcareous tufa were being deposited from more or less saturated waters, a wave cast that pebble on top of the first formed basal or squamous rosette. Then the tufaceous mass, with little increase of diameter, continued its growth and regularity of structure upward as before.

Of such tufa reefs as these, and such pebbly shore lines of the western Cretaceous, little is as yet known, and to my knowledge nothing has been reported hitherto. But inasmuch as the general facts seem to indicate conditions not unlike those found about such recedent lakes as Bonneville and Lahontan, it is hoped this preliminary note may call forth much further observation afield. If those who have perchance seen the tufa reefs, and especially the smoothed pebble beaches, would kindly report their observations I would esteem it a favor. It is not improbable that some considerable and synchronous lacustrine shore lines can be definitely located, a result which would be of the first geologic interest.

To what extent algal life has played a part in the growth of these tufas of more remote geologic time is not fully understood. In the case of all the finely radiate tufas there is less likelihood of substitution of any kind than in the coarser Thinolitic type of Lake Lahontan studied by E. S. Dana. It seems unlikely that the masses often of such striking regularity of form could result from purely inorganic processes.

G. R. Wieland

Yale University

IS HONEY A LUXURY?

In the October 15, 1920, number of Science appeared an article by Mr. J. J. Willaman,

headed "Levulose Sirup," which contained one statement that I believe should be corrected. He states that of the four sugar products, glucose, sorghum, honey and maltose, "sorghum and honey are the only ones that compete with sugar in sweetness," and farther on in the article adds "of the two sweeter products, honey will probably of necessity always remain a luxury." It is this last statement to which I take exception.

Honey should not be considered a luxury. It is the form of sweet that was used long before cane sugar was ever thought of, and is in many places now a staple article of food. During the sugar shortage caused by the late war honey was used to a much greater extent than ever before in this country and thousands of families used honey almost exclusively in place of sugar. In addition, millions of pounds were exported. One reason that honey is often considered a luxury is because it is too frequently bought in such small quantities that the purchaser is paying far more for the container and the labor of putting the honey up in such form than he is for the honey itself. The writer knows a number of families who buy extracted honey regularly in 60 pound lots and consider it a staple article of food rather than a luxury.

Enormous quantities of honey are used in baking in this country, both for home baking and by commercial baking firms, since honey possesses a number of advantages over sugar in baking. It is stated that the National Biscuit Company at one time bought seventy carloads of honey in one lot. Honey is also extensively used in the making of fine candies, high-grade ice cream and soft drinks.

It is a commendable thing to point out as Mr. Willaman has done, how a new industry may be developed, especially when the product of such industry is to be a food, yet it is unjust in pointing out such a possibility to make a statement which tends to foster a mistaken idea, entirely too prevalent already, about another food product, an idea that the beekeeping industry and all its sponsors are trying to eradicate. The beekeeping industry in this country is annually conserving millions upon millions of pounds of one of the finest food products existent that would otherwise be absolutely lost. Yet many times the amount saved is actually lost because this industry is not developed to such an extent as to take care of more than a small percentage of the possibilities. The complete development of this industry can come only when the people as a whole recognize honey as a staple article of food rather than as a luxury.

M. C. TANQUARY
COLLEGE STATION, TEXAS

THE FLIGHT OF FIREFLIES AND THE FLASHING IMPULSE

FIREFLIES are wonderfully interesting creatures. There is something marvellous in the physiology of a lowly living mechanism that can transform chemical energy into luminous energy with such a nearly perfect radiant efficiency and with so little effort as do the fireflies. Theirs is a light without appreciable heating effects, because in some manner the energy of special chemical reactions taking place within their tissues, is transformed almost entirely into luminous energy.

If one observes fireflies[1] closely it will be noted that their flight movements and flashing under certain conditions bear some relation to each other. During the day these insects seek concealment in the low herbage and grass. With the approach of evening they become active and just after sundown may be seen to arise in great numbers from the damp herbage, flashing leisurely from time to time. If the air is still and warm, it will be noted that as the creatures arise very slowly, each flash is attended by a sudden upward flight impulse which may even carry them almost straight upward several feet. Usually, however, they are propelled upward in a more or less curved path.

At this time the flight of the fireflies appears to be very weak, for they drift along aimlessly, and appear almost unable to keep clear of the herbage, often actually descending

[1] These observations apply to the behavior of the species *Photinus pyralis* Linn.

as if to alight again. When it seems that they must inevitably terminate their flight and settle down upon the herbage, another flash renews and quickens the flight impulse and they arise precipitately, as if suddenly propelled upward by some energizing stimulus attending the flash.

This striking behavior may be observed almost any calm evening throughout the summer. It is particularly noticeable when the insects are arising from the herbage, and are just preparing to get fairly on the wing. What is the actual significance of this luminosity to the insects? In what manner does the flash stimulate momentarily the powers of upward flight? It would sometimes seem as if the energy-transformation attending the flash, actually aided them to get fairly on the wing, possibly also sustaining their flight in some manner.

H. A. ALLARD

WASHINGTON, D. C.

SPECIAL ARTICLES

FUNGICIDAL DUSTS FOR CONTROL OF SMUT

FOR more than a century efforts have been made to secure a perfect method of treating cereal seeds to destroy smut spores carried on their surfaces. Many fungicides have been tested and a number of standard formulas have been put forth as efficient. More recent investigations have demonstrated that none of the formulas involving dipping seed in solutions, fumigating with powerful gases or dissolving spores by various solvents, has proven completely successful. Reagents of sufficient strength to destroy the smut spores have proven to be injurious to the germination of the seed.

It has been demonstrated recently by the writers and by many other investigators, that the commonly accepted standard smut fungicial formulas involving the use of bluestone and of formaldehyde, are frequently extremely injurious to the germination of the seed and the development of the seedlings. In arid and semi-arid wheat areas, formaldehyde frequently causes serious losses in seed planted in dry soil. Bluestone, the preferred fungicide in such regions, causes serious losses in germination and delayed growth of seedlings. Threshing operations in semi-arid regions cause greater rupture to seed coats than occur in more humid regions, further increasing seed injury. To avoid these losses, it has been recommended that the bluestoned seed be dipped, after a short drain, in a lime solution to react with the copper and thus check the penetration of the copper sulphate in the seed germ as soon as it has destroyed the bunt spores adhering to the surface of seed. Unless the seed coats have been badly ruptured this formula is very effective but it has been found that the seed does not pass so freely through the drill and, in cold damp weather, the seed dries slowly due to the coating of lime and hence may cause fermentation or heating. To avoid these troubles experiments with bluestone used as a dust were undertaken. The partial success of flowers of sulphur in preventing bunt in California and the reported success with copper carbonate by the Department of Agriculture of New South Wales, gave encouragement for attempting dust treatments.

Little Club wheat dusted with spores of bunt (*Tilletia tritici*) at the rate of 1 part of spores to 750 parts of seed by weight and treated according to standard formulas, gave the following results:

Fungicide	Treatment		Smutted Plants %	Smutted Heads %
	Strength	Germination %		
Check	—	99.0	12.8	6.2
Formaldehyde	1–40	98.0	0.	0.
Copper sulphate	1–4	12.5	0.	0.
Copper sulphate + lime solution	1–4 1–8	80.0	1.7	.4
Copper carbonate	dust	95.3	0.	0.
Copper sulphate	dust	54.1	0.	0.
Copper sulphate dust mixed with calcium carbonate dust (1–1)	dust	98.3	0.	0.
Copper sulphate and lime dusted separately	dust	96.5	0.	0.

Rod row plantings were made March 8, 1920, and later, which accounts for the rather

light smut attack. The seed was harvester thrashed and showed considerable injury to the seed coats permitting maximum bluestone injury. The tests were replicated from 2 to 9 times and the average tabulated.

The results compiled from repeated tests demonstrate the effectiveness of copper sulphate dust when mixed with equal parts of calcium carbonate dust in the control of bunt attack due to seed-borne spores. No damage to seed germination occurred. Copper carbonate dust was equally effective. These dusts, especially the copper sulphate adhered tightly and completely covered all parts of the seed wheat. The process of shaking the wheat in dusting removed a large portion of the bunt spores. Two ounces of the dusts per bushel are considered ample. Copper sulphate and lime are available everywhere at low cost. Further experimentation in representative areas in the wheat belt of the United States is desirable before the dust methods are put into practise among farmers.

W. W. Mackie,
Fred N. Briggs

College of Agriculture and
U.S.D.A. Cooperating,
Berkeley, Calif.

THE AMERICAN ASTRONOMICAL SOCIETY

The twenty-fourth meeting of the society was held on September 1 to 4, 1920, at Smith College, Northampton and Mt. Holyoke College, South Hadley, Massachusetts. The members lived at the Gillett House, one of the residence halls at Northampton. This was the first occasion on which the society had met regularly at a woman's college, and it was a double pleasure to visit two such institutions, and especially to find in what flourishing condition are their observatories and astronomical departments.

There were five sessions for papers at Smith, and two at Mt. Holyoke, where the society went on the second day. A special feature of the meeting was the conversazione at which various exhibits were shown, including the latest work of the 100-inch telescope at Mt. Wilson.

Sir F. W. Dyson, Astronomer Royal, Greenwich, was elected as an honorary member of the society.

The officers for the ensuing year are:

President—Frank Schlesinger.

Vice-presidents—Walter S. Adams, Otto Klotz.

Secretary—Joel Stebbins.

Treasurer—Benjamin Boss.

Councilors—S. I. Bailey, W. J. Hussey, H. N. Russell, V. M. Slipher, Caroline E. Furness and John A. Miller.

The representatives of the society on the National Research Council will hereafter be elected in the same manner as the officers of the society. The present members on the Division of Physical Sciences are: W. W. Campbell, H. N. Russell and Joel Stebbins; and these three together with the president of the society, Frank Schlesinger, and W. S. Eichelberger form the executive committee of the American Section of the International Astronomical Union. The committee will organize the American preparation for the triennial meeting of the union in 1922.

About seventy members of the society were in attendance at the meeting, and fifteen new members were elected. The list of papers, abstracts of which are printed in *Popular Astronomy*, was as follows:

The spectra of some variable stars: W. S. Adams and A. H. Joy.

Note on the spectrum of T Pyxidis: W. S. Adams and A. H. Joy.

Personality in the estimation of tenths: Sebastian Albrecht.

Observations of variable stars at the McCormick Observatory: Harold L. Alden.

Parallax determinations of bright stars: Harold L. Alden and S. A. Mitchell.

Variable stars in Messier 22: S. I. Bailey.

Concerning results of observed gravitational light deflections: Louis A. Bauer.

Ghosts and oculars: Louis Bell.

On telegraphing the position of a celestial object: Ernest Clare Bower.

Notes on the classification of long period variables: Leon Campbell.

Notes on changes in the spectrum of η Carinæ: Annie J. Cannon.

A probable factor in the widening and increase in wave-lengths of the spectrum lines near the limb of the sun: Ralph E. DeLury.

The constancy of the solar wave-lengths and the possibility of determining the solar distance therefrom: Ralph E. DeLury and H. R. Kingston.

Notes on the solar rotation: Ralph E. DeLury and John L. O'Connor.

Map of Mars in 1920 and method of producing it from drawings: A. E. Douglass.

A photometric study of Y Camelopardalis: R. S. Dugan.

The photometric fields of three Yerkes telescopes: Alice H. Farnsworth.

Circulation of calcium flocculia about sun-spots: Philip Fox.

Note on Nova Cygni No. 3: Edwin B. Frost.

Some recent photographs taken with the 100-inch Hooker telescope: George E. Hale.

The Mount Wilson photographic map of the sun-spot spectrum: George E. Hale and Ferdinand Ellerman.

The orbit of the spectroscopic binary H. R. 6385: W. E. Harper.

The light-curve of Eros in 1914: A correction to the results previously published: Margaret Harwood.

A curious effect of superposition of two photographic plates: F. Henroteau.

A graphical construction for obtaining the period of a phenomenon: F. Henroteau.

Nova Cygni No. 3. Preliminary results: F. Henroteau *and* J. P. Henderson.

The spectroscopic binary ν Eridani: F. Henroteau and J. P. Henderson.

New lines in the spectrum of oxygen: C. C. Kiess.

Velocity-curves for spectroscopic binaries: Edward S. King.

Photometry of eclipsed moon: Edward S. King.

The eclipsing binaries μ¹ Scorpii and V *Puppis:* Antonia C. Maury.

Parallax results obtained at the Yerkes Observatory: Oliver J. Lee and George van Biesbroeck.

Photographic zenith tube at the U. S. Naval Observatory, 1915.9–1920.0: F. B. Littell.

The systematic errors of stellar parallaxes determined by photography at the Leander McCormick Observatory: S. A. Mitchell.

Absorption of the photographic rays by the atmospheric water content: George Henry Peters.

The spectroscopic orbits and absolute dimensions of the eclipsing variables TX Herculis and Y Cygni: J. S. Plaskett.

When an eclipse prevented a war: William F. Rigge.

Direct micrometrical observations of the sun. Exact formulas: E. D. Roe, Jr.

The mensurational properties of the photographic plate: Frank E. Ross.

A solution of R minus D observations: Arthur J. Roy.

The radial velocities of ten Oe5 stars: W. Carl Rufus.

On the probable diameters of the stars: Henry Norris Russell.

Radiation pressure and celestial motions: Henry Norris Russell.

The astronomical aspects of aether theory versus relativity: L. Silberstein.

Progress in photo-electric photometry, with a new light-curve of Algol: Joel Stebbins.

The investigation of plate errors in photographic photography: Harlan True Stetson.

Arlington time signals: R. Meldrum Stewart.

Temperature compensation of chronometers: R. Meldrum Stewart.

Canadian transcontinental longitudes: R. Meldrum Stewart.

Notes on the variables 9.1914 and RT Vulpeculæ: S. D. Townley.

A new method of observing the position of the centre of the sun: R. W. Willson.

The orbits of Carinæ, Doradus, and Sagittarii: Ralph E. Wilson and C. M. Huffer.

The orbit of the spectroscopic binary H. R. 8800: Reynold K. Young.

The stationary calcium lines in early type stars: Reynold K. Young.

Joel Stebbins,
Secretary

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, DECEMBER 10, 1920

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE DAILY INFLUENCES OF ASTRONOMY[1]

IN the great struggle through which the principal nations have passed, men and women at home labored intensively to maintain their ideals; countless millions of men fought valiently and many millions died for the ideals of their nations. Quick results, short cuts to the end in view, the achieving of victory regardless of costs, were the order of the day. Suddenly the problems of war gave way to the problems of peace. The intensive methods of war carried over to an unfortunate degree into the days of peace. Human energy, mobilized in behalf of the nation, applied unselfishly for the good of every person in the nation, for the well-being of all the nations, was diverted in regrettable measure to promoting selfish interests. The moral exaltation of the war period was replaced in too many cases by the selfishness of individuals and organizations; by profiteering—a new word, coined to describe widespread conditions. The struggle in Russia, as the extreme case, is direct action for the sudden attainment of certain results, without due consideration for the rights of others. In all countries there are those who, seeing conditions not to their liking, in commerce, in education, in religion, in many phases of daily life, would cut and slash their way through the good, in order to uproot what, in their sight, is bad. This spirit exists in America, and throughout the world, in various degrees. Disturbances in the body politic may ensue for years or a generation by virtue of these attempted short cuts to results, but radical transformations in the social structure of the great modern nations, to endure, must find

[1] Address on the occasion of the dedication of the Warner and Swasey Observatory, Case School of Applied Science, Cleveland, on October 12, 1920.

the people ready for them. The influences which prepare the way for desirable and enduring reforms are not those applied suddenly, but such as operate day and night, continuously, through long periods of time. The revolutions in Russia, in Mexico, in many parts of Latin America attract our attention, but the really serious misfortunes of those lands lie much deeper, in their bad social, educational, economic conditions, which are operating unfavorably upon their civilizations every day of the year.

We may well inquire what it is that bears a nation onward and upward to greater things. It is unquestionably the spirit of idealism radiating from its various activities. It is the idealism in commercial life: that part of every man's affairs which is conducted with full respect for the rights of others; that part of every man's business which would not, through its publication, injure his good name. It is the idealism of the transportation system, which interchanges commodities to mutual advantage, and acquaints one section of the world with the good things of other sections. It is idealism in banking, in farming, in the honest day's labor at an honest wage. It is idealism in the intellectual life: reverence for the truth, a desire to know the truth, and to live in harmony with the truth in one's surroundings.

A pessimist would to-day, as always, receive short shrift, yet I venture to say the world was perhaps never more urgently in need of the biblical advice, "Prove all things; hold fast that which is good." This expression of great wisdom has never been surpassed as a statement of the principles which govern men of science in their search for the truth.

The chief value of scientific method and accurate knowledge lies not in their worship by the intellectual few, not in their applications to industry, but in their influence upon the daily life of the people. The remarkable advance in civilization within the leading nations in recent centuries has been due to the daily and hourly influence of the scientific spirit, more than to any other element. Those nations which possess it are forging ahead by leaps and bounds, and those which do not are dropping out of the race. The unscientific nations are threatened with absorption by their more scientific neighbors, not so much because they do not invent or perfect the most powerful cannon, the sturdiest dread-naught, the speediest airplane, or the subtlest submarine, but because the scientific nations are forging ahead of them in the arts of peace, in the modes of thought, in the affairs of daily life. The unscientific nations are without serious influence in the world, not because they are unwarlike—the Turks and essentially all Mohammedans are warlike enough to suit everybody—but because they are lacking in the vision and the efficiency which accompany the scientific spirit.[2]

History affords no more remarkable phenomenon than the retrograde movement in civilization which began with the decline of the Roman power and continued through more than a thousand years. There had once existed a wonderful Greek civilization, but for twelve or fifteen centuries it was so nearly suppressed as to be without serious influence upon the life of the European peoples. Greek literature, one of the world's priceless possessions, not surpassed by the best modern literatures, was as complete two thousand years ago as it is to-day. Yet in the Middle Ages, if we except a few scattered churchmen, it was lost to the European world. A Greek science never existed. Now and then, it is true, a Greek philosopher taught that the earth is round, or that the earth revolves around the sun, or speculated upon the constitution of matter; but excepting the geometry of Euclid and Archimedes, we may say that nothing was proved, and that no serious efforts were made to obtain proofs. There could be no scientific spirit in the Greek nation and Greek civilization so long as the Greek religion lived, and the Greek people and government consulted and were guided by the oracles. If there had been a Greek science equal in merit

[2] This and the following paragraph have been taken, with but few changes, from one of my earlier addresses.—W. W. C.

to modern science, think you that stupidity and superstition could have secured a stranglehold upon Greek civilization and have maintained a thousand years of ignorance and mental degradation? Intellectual life could not prosper in Europe so long as dogma in Italy, only three hundred years ago, in the days of Bruno and Galileo, was able to say, "Animals which move have limbs and muscles; the earth has no limbs or muscles, therefore it does not move;" or as long as dogma in Massachusetts, only 250 years ago, was able to hang by the neck until dead the woman whom it charged with "giving a look toward the great meeting house of Salem, and immediately a demon entered the house and tore down a part of the wainscoting." The morals and the intellect of the world had reached a deplorable state at the epoch of the Borgias. It was the re-birth of science, chiefly of astronomy, as exemplified by the work of Columbus and Copernicus, and secondly the growth of medical science, which gave to the people of Europe the power to dispel gradually the unthinkable conditions of the Middle Ages.

It has been said that we may judge of the degree of civilization of a nation by the provision which the people of the nation have made for the study of astronomy. A review of present-day nations is convincing that the statement represents the approximate truth. It is essentially true even of sections of our own country. In our first years as a nation a few small telescopes were in private hands, here and there; they were used merely for occasional looking at the stars; there were no observatories in the United States—no telescopes suitably mounted and housed for the serious study of the stars. The founding of the third American observatory, at Hudson, Ohio, about 1839, only a year or two after the completion of the second observatory, at Williams College, Massachusetts, was an admirable index to the intellectual outlook of the Western Reserve.[3] The laying of the corner stone of the Cincinnati Observatory in 1843, a wonderfully ambitious institution for its day, was an event considered by Ex-President John Quincy Adams to be worthy of a hard trip, in the seventy-seventh year of his life, by rail from Massachusetts to Buffalo, by lake steamer to Cleveland, by four days of miserable canal boat to Columbus and thence on to Cincinnati, to deliver the formal address —then called an *oration*. Adams's task was, to quote his words, "To turn this enthusiasm for astronomy at Cincinnati into a permanent and persevering national pursuit, which may extend the bounds of human knowledge, and make the country instrumental in elevating the character and improving the condition of man upon earth."

Our former slave states have to-day only one active observatory, at the University of Virginia, presented by McCormick of Chicago. Barnard and other astronomical enthusiasts, born and grown to manhood in the south, have found their opportunities in the great northern observatories. What is true of astronomy in the south is true, in general, of the other sciences. This unfortunate result is the natural product of the false, unscientific system of labor which, prevailing through many generations, taught that it is undignified for the white man to eat bread by the sweat of his own brow. Financial recovery, following 1865, has accordingly been slow. The future will correct this, for the men of the south are our blood brothers. We should be, and are, sympathetic.

Shall we try to estimate what astronomy, the oldest of the sciences, sometimes called an ideal and unpractical science, has done for mankind?

Here are some of the applications of astronomy to daily life.

1. Observations of the stars with the transit instrument, such as exists in this observatory, are supplying the nations with accurate time. Two astronomers, with modern instrumental equipment, situated on the same north and south line, may observe the stars so accurately, in comparison with the beats of their common clock, that they will agree

[3] The northeastern part of Ohio constitutes the "Western Reserve."

within two or three hundredths of a second as to how much that clock is fast or slow.

2. The accurate maps of the continents and islands depend upon the astronomical determinations of the latitudes and longitudes of their salient features.

3. The sailing of ships over long courses, say from the Golden Gate to Sydney, Australia, or from New York to the Cape of Good Hope, depends upon the A B C's of astronomy. Given fair skies the navigator may locate his ship in the middle of the broad ocean within a mile of its true position.

4. In America it is the habit to call upon the astronomers to fix the boundary lines between nations, by observations of the stars; for example, along the 49th parallel of latitude, from Rainy Lake, Minnesota, westward almost to the Pacific Ocean. The uncertainty as to where this imaginary line falls upon the ground is nowhere greater than ten or fifteen feet, and it has not been found necessary by us, nor by our friends in Canada, to maintain military forts along that line.

5. The times of high and low tides, vital to mariners in entering many harbors, are determined by or from the work of the astronomers.

We do not dwell upon these responses to the immediate needs of the world, for they are unimportant in comparison with the contributions of the pure knowledge side of astronomy to progressive civilization.

Let us think of the earth as eternally shrouded in thick clouds, so that terrestrial dwellers could never see the sun, the moon, the comets, the stars, and the nebulæ, but not so thick that the sun's energy would fail to penetrate to the soil and grow the crops. Under these conditions we might know the earth's surface strata to the depth of a mile or two. We might know the mountains and the atmosphere to a height of four or five miles. We might acquire a knowledge of the oceans, but we should be creatures of exceedingly narrow limits. Our vision, our life would be confined to a stratum of earth and air only four or five miles thick. It would be as if the human race went about its work of raising corn for food and cotton for raiment, always looking down, never looking up, knowing nothing of the universe except an insignificantly thin stratum of the little earth. This picture is only a moderately unfair view of life as it existed on our planet four hundred years ago, before the days of the telescope, the spectroscope and the photographic plate, before the days of freedom of speech and thought, which came with the scientific spirit. The earth is for us no longer flat, supported on the back of a great turtle, which rests upon nothing. It is round, and every civilized person knows that it is. Exists there an intelligent man in the world whose thoughts, every day and many times a day, are not unconsciously adapted to this fact? This knowledge is a chief inheritance of the new generations. It is fundamental in our civilization. People know that the sun will rise in the morning and set in the evening, and why. A round earth, rotating upon its axis in a dependable way and revolving around the sun in exact obedience to law, are truths incomparably more sublime than the fiction of the flat earth which was pictured hazily in men's minds during pre-Copernican days. Who can estimate the value of this knowledge to the human race? It can not be expressed with the few figures which suffice for the total of present-day financial transactions.

The stars are not lanterns hung out in the sky by angels at night, but something inconceivably grander; they are suns, hundreds of millions of suns, on the average comparable in size and brightness to our sun. Is not this ascertained fact of nature a most ennobling one to aspiring souls? Do not these facts suggest and develop becoming modesty in the minds of those who would know the truth and pattern their lives in accordance with it?

The following conversation occurred one Saturday evening in the month of June, 1912, at the eyepiece of the great telescope which Mr. Warner and Mr. Swasey constructed and erected for the Lick Observatory: I mention the time, June, 1912, because it is of the essence of the story.

Said the astronomer to the party of visitors: "The object which you will see through the great telescope this evening is the star cluster in Hercules, the finest cluster in the northern sky. Without the telescope, by naked eye, this cluster may be seen if the observer knows exactly where to look and has first-class eyes, but he will see it as apparently a single star on the limit of vision, so faint that many eyes will not see it at all. The telescope separates the cluster into a multitude of stars. If you had the time to count them, they would number fully six thousand, closely grouped in the center of the cluster, but thinning out as you approach the edges. This one object, then, which to the naked eye seems to be a single star on the limit of vision, consists of at least as many stars as the eye alone is able to see in the sky as a whole, northern and southern skies, summer and winter skies combined, and we do not doubt that long photographic exposures on the cluster, with a large reflecting telescope, would record many more than six thousand. Each of these stars is a sun and probably every one of those which you will see is larger than our sun,, for we are observing merely the brightest members of the system. We do not know whether these suns have planets revolving around them or not, as the cluster is entirely too far away for us to see such planets, but planets probably exist there in great numbers; possibly there are planets revolving around all of those stars; possibly and probably there are moons revolving around the planets; and finally, there may be life, vegetable, animal, intelligent life upon those planets."

One of the visitors upon descending from the observing chair, much interested, questioned the astronomer: "Did you say those stars are all suns?" "Yes, sir." "Did you say that those stars are really larger than our sun, on the average?" "Yes, sir." "Can you give me an idea how large our sun is?" "Well, if it were a hollow shell, of its present size, you could pour more than a million earths into it, and there would still be much unoccupied space between the earth balls." "You say, there are possibly or probably planets revolving around many of the cluster stars?" "Yes, sir." "And many of those planets may be inhabited?" "Yes, sir." "Well then, I think it does not matter very much whether Roosevelt or Taft is nominated next week at the Chicago Convention."

Of course the visitor's interest in the outcome at Chicago was just as keen as ever, but he had evidently received a valuable lesson concerning man's place in nature.

The wonders of our sun are many and most remarkable, and are but little known. I have referred to its enormous size. The quantity of heat which the sun is radiating into surrounding space, to the earth, to Mars, and to all other objects which intercept its rays, is stupendous and not to be comprehended by the astronomer or the man of affairs. It is, and has been, the source of all the energy upon which we draw, save only a negligible residual. A great quantity of heat is indeed stored up in the interior of the earth, but it reaches the earth's surface in such minute quantities that in all practical details of life, save to those who labor in deep mines, or live near volcanoes, or are interested in hot springs, this source of energy may be neglected. If this statement should be difficult to accept, let your thoughts travel to the south pole of our planet. What does the interior heat of the earth do for that region? The antarctic continent's perpetual covering of ice and snow is unaffected by it, nor does the actually enormous quantity of solar heat falling upon that continent suffice to remove the white mantle. If aught should intervene to cut off the sun's energy from the earth for one short month, the tropics would attain to a state of frigidity to which the south polar continent, as now observed, would be a rose garden in comparison.

It is the sun's heat which grows the farmer's crops, the trees of the forest and all vegetation. The coal deposits upon which we draw to-day for the running of trains, ships, factories and rolling mills, are but the solar energy of an earlier age, compressed, transformed and preserved for our comfort and power. In the mountainous regions of our

land, where water can be stored in high level reservoirs and, passing through water wheels at lower levels, be made to generate electric power for lighting, for heating and for the running of motors, it is the sun's energy which is transformed to meet the needs of men. The sun's rays evaporate the surface waters of the oceans, lakes, streams and lands; the winds, generated by the unequal solar heating of our atmosphere, transport some of the water vapor to the high mountains, where it is deposited as rain or snow. It is merely the descent of these waters to the lower levels that is controlled by man and transformed into electric power for his own purposes.

It would take more than two billion earths placed side by side to form a continuous spherical shell around our sun at distance equal to the earth's distance, and thus to receive the total output of solar heat. Therefore less than one two-billionth part of that output falls upon the earth. The earth's share of solar energy, expressed in horse-power or other familiar units, is too great to set down in figures. If you should happen to own 250 acres of land in one of the tropical deserts of the earth, you will be interested to know that your quota of the solar energy, near the middle of a summer day, is falling upon your tract of land at the rate of about one-million horse-power—more than enough heat and power to supply all the needs of this great city—and this is but two thirds of the sun's good intentions toward you, for some 40 per cent. of the energy is intercepted by the atmosphere overlying your farm, and returned forthwith to outer space.

Your neighbor's tract of 250 acres is also receiving solar energy at the rate of one million horse power. Figuring backward, if one farm area receives a million horse power, and there are more than a hundred million such farm areas on the earth turned toward the sun at one time, and the whole earth intercepts less than one two-billionth of the sun's energy output, is it any wonder that sun worship became one of the recognized religions? Accurate knowledge saves us from that, but it is becoming in us to give the sun our due respect.

A great problem ahead of the scientific world is the storage of the sun's beneficent heat rays for release as needed. Astronomers are seeking intently for the sources of the sun's outpouring of energy: how can the sun maintain the supply for tens of millions of years, as it undoubtedly is doing? One important source has been found—the sun's own gravitation which tries constantly to pull every particle of its material to the sun's center—but another and greater source seems to await discovery. Does any one say, since the supply of solar energy will surely meet our needs for ten or a hundred million years, why look further for the cause? Why not let it go at that? This selfish spirit, if applied to all subjects, would retrograde our civilization. Even the possession of the truth is not so potent for good as the desire to know the truth, and the struggle to discover it. Practically, a knowledge of the origin of the sun's heat may be the key for locking up great quantities of it on summer days and unlocking it when and where needed.

Who is not interested in Mars, a planet much smaller than the earth, a little over four thousand miles in diameter, which revolves around the sun in somewhat less than two years, at an average distance from the sun fifty per cent. greater than the earth's distance? Mars is literally one of the earth's brothers, and we should be sincerely interested in his welfare. Does life exist on that planet? Almost certainly there is vegetable life. We have no reason to doubt it. Certain areas of the planet change in color as the climatic seasons come and go, very much as we should expect if these colors were controlled by the natural stages of vegetable life. However, in precaution, I should guard against the drawing of the conclusion that vegetable life on Mars has actually been proved to exist. I can merely say that we see no reason to doubt its existence. Is there animal life on Mars? There probably is, but we have no positive evidence that such is the case. If the physical conditions on the planet as to water, air

and soil are such that vegetable life may exist, the chances are strongly in favor of animal life also. However, I think we must leave unanswered for the present the question whether such animal life is highly intelligent. The forests of the St. Lawrence Valley and the prairies of the Mississippi Valley put on their green coats in the spring and changed them to brown coats in the fall, perhaps even better before the coming of man than after his destructive influence descended upon them. If you had the means to ascend several thousand miles above your present position, and could dwell there throughout the year, you would witness the formation of a polar snow cap upon the earth early in the autumn. The southern edge of this cap would extend farther and farther to the south up to the time of mid-winter. Its edge would extend well down toward the southern limits of the United States, to the Himalayas in Asia, and so on. With the coming of spring the north polar cap would decrease in size and probably disappear, save as to snows on the higher mountains and the possible ice and snows of the immediate polar region. An observer similarly situated above South America would witness similar phenomena as to the south polar regions; and these are indeed the phenomena observed on the planet Mars. The white polar caps on Mars wax and wane with the coming and going of the winter as they do upon the earth. Superficially, the Martian conditions seem not very different from the terrestrial, though we know that the Martian atmosphere is highly attenuated, and if we were suddenly set down upon that planet's surface we should certainly suffocate for lack of air. Water is probably scarce upon that planet in similar degree. However, these facts do not militate strongly against animal life upon that planet, for such life would undoubtedly be developed with respiratory and other organs adapted to their environment. A solution of the Martian problems, as to a possible counterpart of terrestrial man on that planet, is apparently not now hopeful, but present-day failures may be the prelude to future successes, and I prefer to offer no discouragement.

The planet Venus, only a shade smaller than the earth, and but two thirds as far from the sun as we, presents a similar but apparently more difficult problem. We know that it has an extensive atmosphere, no doubt comparable with that of the earth, but concerning the presence of water we are justified in making no statement other than that we remain in apparently total ignorance. If Schiaparelli was right, as he appears to have been, that Venus always presents the same face to the sun, just as the moon always turns the same hemisphere toward the earth, then one hemisphere of Venus undoubtedly remains intensely hot in perpetuity, and the other hemisphere in perpetual darkness and excessively low temperature. Can the twilight zone between the hemispheres of day and night offer abode and comfort to living forms, vegetable and animal? We have found no answer to this question, and we know not how to progress to the solution.

Are the moon and Mercury inhabited? Certainly not by such forms of life as we are familiar with, for neither object has an appreciable atmosphere. Both bodies undoubtedly suffer from extremes of heat and cold, without the protecting blanket of atmosphere with which the earth is blessed. The other planets, Jupiter, Saturn, Uranus and Neptune, may be dismissed as uninhabitable by life forms of our acquaintance. There seems no reason to doubt that these great bodies, from four to eleven times the earth in diameter, are still devoid of solid footing for man or beast, such as the rock and soil strata afford upon the earth.

Have astronomers been able to prove that planets revolve around other suns than ours? No, the distances of the nearest stars preclude that possibility to our means in hand. Such planets would need to be many-fold brighter than Jupiter, the greatest of our planets, and our great telescopes would need multiplication many times in diameter to let us see them as attendants of their suns. We are able to prove, and have proved, however, the existence of

hundreds of bodies, in distant space, whose rays of light we have not perceived. The spectrograph has shown with certainty that, of the naked-eye stars, one in four on the average is not the single star which it appears to be to the naked eye, or when viewed in the telescope, but that it is a double sun, the two bodies revolving continuously about their mutual center of mass. These hundreds of binary systems are so far away that even under the highest telescopic magnification they blend into a common and essentially mathematical point. It is the expectation that the future, possibly the present century, will establish that one star in three, on the average, is a double solar system. It may even prove to be the truth that our solar system, consisting of one great central sun and many attendant planets, is not the average and prevailing system, but is the exception and not the rule. However, we have no good reason to doubt that tens of thousands, more probably tens of millions, of distant suns are the centers of planetary systems, and that countless planets are the abode of life. As our sun is but one of hundreds of millions of suns, it is absurd and essentially inconceivable that our planet, or two or three of our planets, should be the only bodies throughout the universe supporting life. It is vastly more probable that if our vision could penetrate to other stellar systems, lying in all directions from us, we should there find life in abundance, with degrees of intelligence and civilization from which we could learn much, and with which we could sympathize. The spectroscope proves absolutely that dozens of chemical elements in the earth's surface strata exist in our sun: that iron, the silicon of our rocks, hydrogen, helium, magnesium and so forth exist in the distant reaches of our stellar system. If there is a unity of materials, unity of laws governing those materials throughout the universe, why may we not speculate somewhat confidently upon life universal?

In the days of my youth, here in northern Ohio, the opinion prevailed throughout the community, and widely over the earth, that comets were the forerunners of wars, plagues or other forms of dire distress. Did not the great comet of 1811 herald the war of 1812, and that of 1843 the Mexican War and Donati's comet of 1858 our Civil War? Even in the twentieth century the fear that a comet may collide with the earth and destroy its inhabitants comes to the surface, here and there, every time a comet is visible to the naked eye. The findings of astronomers concerning these visitors to our region of space have taught that we have nothing to fear from them, and that their close approaches may be welcomed, for they are interesting members of our sun's family. They revolve around our sun as the planets do, and render unto it homage and obedience. It is undoubtedly true that the earth has plunged through the tails of comets many a time and without appreciable effects upon our health and happiness. In fact, the inhabitants have at the time been blissfully unaware of the passage. It is true that a collision of the condensed head of the comet with the earth is not impossible; it may some time occur; but comprehensive studies of this question, based upon observational data concerning many of these bodies, lead indubitably to the conclusion that we must not expect these collisions to occur, on the average, more than once in 15 or 20 million years. The so-called shooting stars, which we have all observed in the night sky, are in many cases, perhaps in all, though we do not know, the burning of minute pieces of comets which have disintegrated and disappeared as comets forever from our sight. Colliding with the earth, rushing through the upper strata of our atmosphere with speeds up to 40 or more miles per second, the frictional resistance of the air heats them to the burning point, and they are turned into ashes and the vapors of combustion. A very few get through to the earth's surface and are found and placed in our museums. It is not certain that any of those in the museums are parts of disintegrated comets, but some of them probably are. The number of small foreign bodies which collide with our planet every day is very great; a conservative estimate is 20,000,000. Except for our beneficent atmosphere man would suffer many tragedies from the bombardment. There is reason to believe that the earth is

growing larger very slowly, from these accretions, and this may have been the process by which the earth grew from a small nuclear beginning up to its present size.

Astronomers have determined that our solar system is very completely isolated in space. We are widely separated from our neighbors. I shall not try your patience by quoting the tremendous distances in miles, for they are incomprehensible to all of us. Rays of light sent out by the sun require a little more than eight minutes to reach the earth. The outermost known planet in our system, Neptune, would be reached in four hours and a half. Rays of light leaving the sun at the same time and travelling at the same rate, 186,000 miles per second, must travel continuously during four years and a half to reach our nearest known neighbor in space, the bright double star Alpha Centauri. If the distance from the sun to the earth is *1*, the distance to our outer planet is *30*, and the distance to Alpha Centauri is *275,000*. There appears to be an abundance of room in the great stellar system to meet the requirements of all. The spectrograph attached to the Lick telescope has determined that our sun and its family of planets is traveling through the great stellar system with a speed of twelve and a half miles per second, equivalent to four hundred million miles per year. The earth is certainly hundreds of millions of years in age, the sun is no doubt at least as old, and the early youth of the earth was lived, not where we now are, but far elsewhere in the stellar system; and its future journeyings will lead to quite other points of observation.

The question of greatest interest to present-day astronomers is that of stellar systems other than our own. The chances seem strong that the hundreds of thousands of spiral nebulæ known to exist in very distant space are other and independent systems of stars, many of them perhaps containing as many stars as our stellar systems. In other words, our stellar system may be but one of hundreds of thousands of isolated stellar systems distributed through endless space. This is not an established fact, but the evidence seems to run in its favor.

I have referred to some of the problems and results of astronomical science. The list of interesting items is a long one, but available time has its limits. In brief, it is the astronomer's duty to discover the truth about his surroundings in space, and make it a part of the knowledge of his day and generation. The ultimate and real value of his work lies in its influence upon the lives of the people of the world, in the changes for the better which it induces in their modes of thought, and in the impulse which it gives to an advancing civilization.

Would that the attractions of the sky to the average man were more potent. It is a curious comment upon the attributes of city life that hundreds of thousands of people, especially children, in London and Paris, in the darkness which gave them semi-concealment from the enemy's destructive air ships, should have obtained their first real vision of the starry heavens. What must have been their sensations? On the other hand, those who can view its beauties and wonders are prone to neglect it; to look down instead of up. Emerson has said somewhere in his immortal essays that if our sky should be clear of clouds but one night in a century, the people of this globe would look forward to the rare event, and not only prepare to behold its beauties themselves, but make sure that their friends far and wide were likewise minded. How the beauties of the night sky would surpass the expectations of the most lively imagination! The wondrous vision would be the prevailing subject of conversation for years and years, and the repetition of the vision, one hundred years later, would need no advertising.

Our knowledge of the heavens is in its infancy. We have but made a start upon the discovery of the truth about the stars, and the results of astronomical research are not so widely known amongst the people as they should be. This splendid institution, The Warner & Swasey Observatory, presented by men who are masters in telescope and observatory design and construction, by men who

have thought much of relative values in life, this institution has a field of great usefulness lying before it. In their administration of the generous gift, the trustees, the president and the faculty of the Case School of Applied Science, whether for research, for school instruction or for community education, will have the sympathetic interest of astronomers, of all lovers of the truth. This observatory may assist in the solution of important problems concerning the universe of which we form a part. The universities, the colleges and the technical schools of our country, and of other countries, are graduating every year many hundreds of young men, ready to start upon the more serious phases of their lives, who can tell us all about the lights in our houses, but not one word about the lights in our sky. This institution will do its quota in approximating to a liberal education. The casual visitor who enters its portals in search of knowledge, yea, the passer-by in the street who merely sees a dignified and purposeful observatory set upon a hill, will have his thoughts directed to higher levels.

W. W. Campbell

Lick Observatory,
University of California

PLAN OF THE BICENTENARY EXPEDITION TO THE NORTH OF GREENLAND

In the year 1721 Hans Egede left Copenhagen for Greenland; with this event the systematic colonization of the vast arctic territory by the Danish State began. In celebrating the bicentenary of this colonization it is natural not only to review what has been achieved, but also to look forward to what still remains to be done both in administration and in research.

The whole coast-line of Greenland is now known. Every point of the coast, extensive as that of a continent, commemorates by its name the glorious achievements of explorers. As a rule, the big nations were before us as far as the discovery itself was concerned, but we may safely say that Danish research has deepened and perfected the knowledge of the new coast-lines. Stubbornly and unweariedly we have carried our flag to the North on both coasts.

The coast of Peary Land, the remotest, most inaccessible part of Greenland we have reached from both sides. The "Danmark" Expedition reached Peary's Cairn on Cape Bridgeman and the Second Thule Expedition, in which I took part myself, reached the De Long Fiord. There still remains a stretch of coast which no Dane has ever seen, and the interior of this country, almost as large as Denmark, is absolutely unknown.

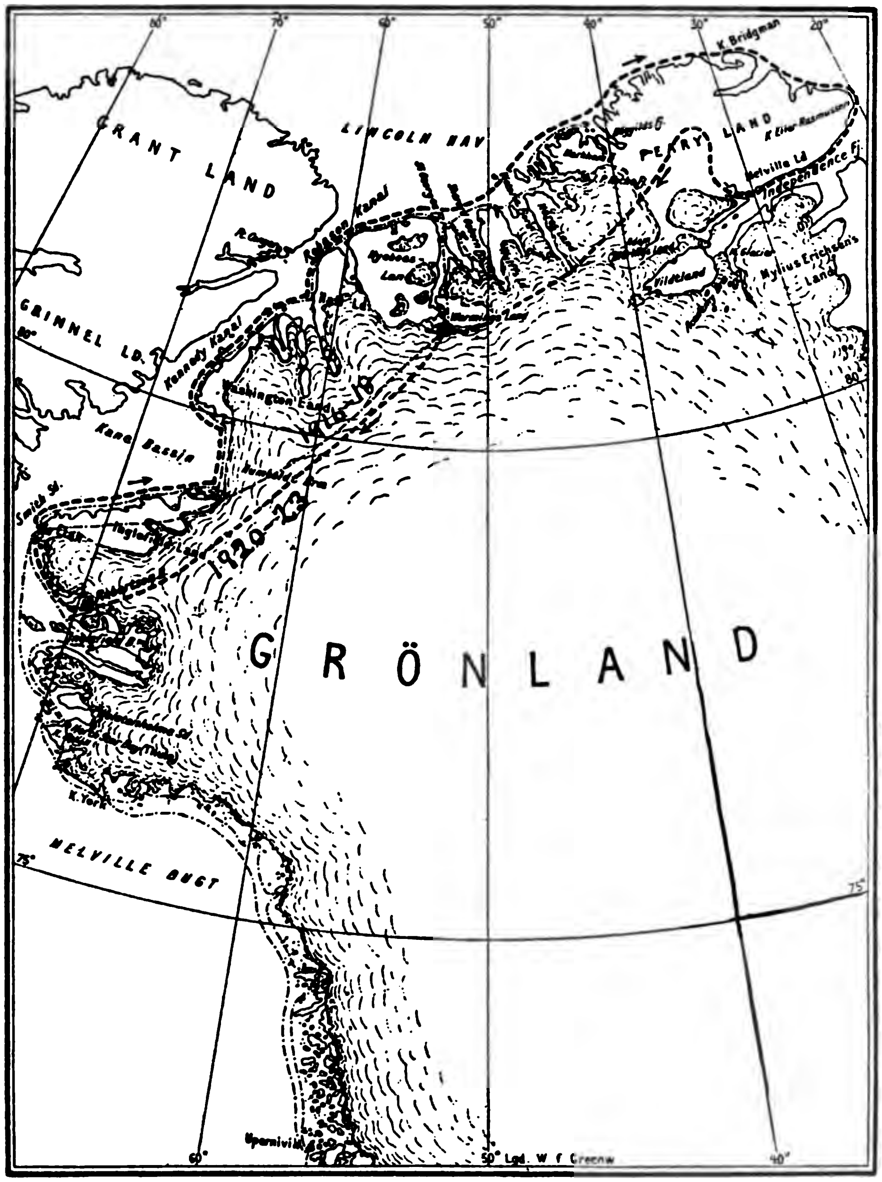
On the Second Thule Expedition, conducted by Knud Rasmussen, it fell to me not only to map out great ice-free territories, which had hitherto been unknown, but also to demonstrate that these new territories are geologically among the most interesting in Greenland, and that the so-called Caledonian Fold, which had hitherto been known to exist only in northern Europe stretched across to the other side of the Atlantic.

Though our results are confirmed by the collections which we succeeded in bringing home in spite of the greatest difficulties, I realized even while working in the field, that great problems still remained to be solved. Another expedition is planned the aim of which will be exclusively geological and geographical research.

Headquarters with a wintering station will be established in Robertson Bay in Inglefield Gulf. From here the following expeditions will be made:

1. A large provision cache for future journeys is to be taken across the Inland Ice from Inglefield Gulf to Warming's Land.[1] The transport will take place in the late summer, when the temperature is comparatively high and the surface snow is melted down or compressed. For this reason it is to be undertaken by Cleveland Tractors, which will be able to work across the ice-free marginal zone at Inglefield Gulf.

[1] South of Sherard Osborne Fiord. The writer's map of the regions surveyed by the Thule Expedition has been printed and will soon be published.



2. The next year the same journey will be repeated in dog-sledges to the cache and from there to the interior of Peary Land and to the north of Adam Bierings Land, an advanced base being established in Valmuedalen, from which various short journeys will be undertaken: to Independence Fiord where Mylius Erichsen's account of his journey is to be found, and northwards to Böggild's Fiord. On the way back, the part of Wulff's Land and Warming's Land, which I did not succeed in mapping out on the second Thule Expedition, will be surveyed. The main cache will be passed on the way back in August.

3. The following spring it is planned to proceed from headquarters along the coast, through Robeson Channel and further to the north of Peary's Land into Independence

Fiord. From thence to the main cache, from which the homeward journey will be made.

My Danish companion on these travels will be Mr. C. F. Slott, an engineer who during many years and in many countries has almost exclusively devoted himself to the study of tractors and their practical working. On the sledge-journeys I shall be accompanied by Polar Eskimos.

The cost of the expedition is estimated at 110,000 Danish Kroner, part of which has been guaranteed by the Danish State. The remainder was raised by a committee consisting of:

MR. C. F. WANDEL, former rear-admiral of the Royal Danish Navy, *Chairman*.

MR. A. ERLANDSEN, shipowner, *Treasurer*.

MR. J. DAUGAARD-JENSEN, director of the administration of the colonies in Greenland.

MR. V. GLÜCKSTADT, of the Merchants' Guild, consul general for Italy.

MR. EUGENE WARMING, former professor of the University of Copenhagen.

The state has placed a ship at our disposal in order to take the expedition and its stores to Inglefield Gulf. This ship left Copenhagen on July 15, 1920.

LAUGE KOCH

COPENHAGEN

SCIENTIFIC EVENTS

UNIVERSITY OF TORONTO CONFERENCE ON RECENT ADVANCES IN PHYSICS

WITH a view to stimulating interest in research, the president and the board of governors of the University of Toronto have heartily approved of a proposal made to them to convene, during the present session, a conference on recent advances in physics. This conference will be held in the physics laboratory of the university between January 5 and 26, 1921.

Dr. Ludwik Silberstein, late professor in the University of Rome, and at present mathematical adviser to the Eastman Kodak Co., of Rochester, N. Y., has kindly consented to take the leading part in the conference. Dr. Silberstein is a distinguished mathematician and mathematical physicist and, during the period of the war, served as expert adviser to the important British optical firm, Messrs. Adam Hilger, Ltd., of London, England. By his training in Europe and by his own contributions to modern science, he is eminently fitted to speak with authority on his chosen themes. Dr. Silberstein will deliver a course of eighteen lectures on the special and generalized theories of relativity and gravitation and on some of the recent advances in spectroscopy and theory of atomic structure. In the latter courses there will be presented the theories put forward by Bohr and by Sommerfield on the origin of radiations, and by Epstein on the Stark effect, in addition to Dr. Silberstein's own investigations on non-spherical nuclei. From the nature of the subject the treatment will be chiefly from the mathematical standpoint.

Dr. Irving Langmuir, of the research laboratory of the General Electric Co., of Schenectady, N. Y., has also kindly consented to take part in the conference on January 17, 18 and 19. On these days he will deliver a short course of lectures on Theories of atomic structures, and other topics.

Provision has also been made in the conference for a course of sixteen lectures on a more or less popular nature. This course will be given by Professor McLennan. It will deal with various aspects of recent researches on the structure of matter and on the origin and characteristics of radiation. The dominant aim will be to present as simply and as clearly as possible the results of investigations which have been made up to the present on various phases of the subjects treated. The lectures of this course should prove of interest to science workers generally and to those of the public who are especially interested in the philosophical aspect of science or in some of its important applications.

A course of lectures will also be given on the fundamental properties of colloidal solutions. More and more in industry is a knowledge of colloids and their chemical properties becoming essential and it is expected that these lectures will prove interesting and profitable to manufacturers as well as to scientific workers. Professor E. F. Burton, both on account of his investigations in this subject and from

his training is highly qualified to deal with the subjects of colloids from its theoretical standpoint, as well as its practical side.

Arrangements will be made for holding a series of discussions during the conference on the subjects treated in the lectures.

The conference will be opened by Sir Robert Falconer, LL.D., president of the University of Toronto, on Wednesday, January 5, at five o'clock, when Professor McLennan will deliver the opening lecture on "Molecules and atoms."

J. C. McLENNAN,
Professor of Physics

UNIVERSITY OF TORONTO,
November 22, 1920

MEETING OF THE AMERICAN ORNITHOLOGISTS' UNION

THE meeting of the American Ornithologists' Union in Washington, D. C., November 8–11, 1920, was one of the largest in the history of the union. One half of the Fellows and about ten per cent. of the entire membership were in attendance. The business meetings on Monday were held at the Cosmos Club and the other sessions at the U. S. National Museum. The election of Fellows and Members included Robert Cushman Murphy, of Brooklyn, N. Y., as Fellow; E. C. Stuart Baker and Dr. Percy Lowe, of London, Honorary Fellows; 13 Foreign Corresponding Fellows; 5 Members and 307 Associates. The election of officers for 1921 resulted as follows: President, Dr. Witmer Stone, Philadelphia; Vice-president, Dr. George Bird Grinnell and Dr. Jonathan Dwight, New York; Secretary, Dr. T. S. Palmer, 1939 Biltmore St., Washington, D. C.; Treasurer, W. L. McAtee, Biological Survey, Washington, D. C. The single vacancy in the council was filled by the selection of Dr. W. H. Osgood, of Chicago, and the other six members were reelected. The program of nearly 40 papers, five of which were illustrated by motion pictures, covered a wide range of subjects relating to North American birds and also included papers on the birds of Argentina, Nicaragua, Peru, Europe and Madagascar. In connection with the meeting an exhibition of drawings, paintings and photographs of birds by American artists, supplemented by a series of prints showing the development of zoological illustration as applied to birds from the earliest times down to date, was arranged in the Division of Prints in the Library of Congress.

T. S. PALMER,
Secretary

THE BULAWAYO MEETING OF THE SOUTH AFRICAN ASSOCIATION

THE eighteenth annual session of the South African Association for the Advancement of Science was held in Bulawayo, Southern Rhodesia, on July 14–17, with Dr. I. B. Pole Evans, as president. From the report in *Nature* we learn that there were the usual receptions and functions, together with visits to the Khami ruins, the Matoppos, the Victoria Falls and Livingstone. A party, after the conclusion of the official meeting, visited the Great Zimbabwe. More than sixty papers were read in the various sections, and the attendance was a large one more than 130 members proceeding by special train from the Transvaal, as well as some from the Cape Peninsula and Natal.

The president Dr. I. B. Pole Evans, chief of the Division of Botany and director of the Botanical Survey of the Union, gave a most interesting address on "The veld: its resources and dangers," the address being illustrated by a series of beautiful lantern-slides. He reviewed recent progress in botanical knowledge, and outlined the notable advance that had been made by the members of the Botanical Survey in respect to systematic ecology, indigenous grasses, fungi and poisonous plants. Mr. H. E. Wood, of the Union Observatory, Johannesburg, as president of Section A, gave an address on "Recent progress in astronomy," noting that the present year was the centenary of the foundation of the Royal Observatory at the Cape. "Geology in relation to mining" was the subject of the presidential address to Section B, given by Mr. F. P. Mennell, who has seen all the later developments in the mining industry of Rhodesia. Dr. T. R. Sim, late government

forester in Natal, delivered the presidential address to Section C on "Causes leading towards progressive evolution of the flora of South Africa." In Section D the presidential address was delivered by Mr. C. W. Mally, Cape Entomologist, whose subject was "Some zoological factors in the economic development of South Africa." The Rev. H. A. Junod, president of Section E, gave a most interesting address on "The magic conception of nature among Bantus." "Labor conditions in South Africa" was the subject of Professor R. Lehfeldt's presidential address to Section F. An evening lecture was delivered by Professor J. A. Wilkinson on "The nitrogen problem."

The South African medal and grant were awarded to Professor E. Warren. Johannesburg is now the seat of the headquarters of the association, and the next meeting will be held at Durban in July, 1921.

SCIENTIFIC NOTES AND NEWS

At the anniversary meeting of the Royal Society on November 30 the following medals were conferred by the retiring president, Sir Joseph Thomson: A Royal medal to Mr. W. Bateson, for his contributions to biological science, especially his studies in genetics, and a Royal medal to Professor G. H. Hardy, for his researches in pure mathematics, particularly in the analytic theory of numbers; the Copley medal to Mr. H. T. Brown, for his work on the chemistry of carbohydrates, on the assimilation of atmospheric carbon dioxide by leaves, and on gaseous diffusion through small apertures; the Rumford medal to Lord Rayleigh, for researches into the properties of gases at high vacua; the Davy medal to Mr. C. T. Heycock, for his work in physical chemistry, especially on the composition and constitution of alloys; the Darwin medal to Professor R. H. Biffen, for his work on scientific principles applied to the breeding of plants; and the Hughes medal to Professor O. W. Richardson, for his work in experimental physics, especially thermionics.

At the meeting of the Geographical Society of Philadelphia, held on December 1, the Elisha Kent Kane gold medal of the society was conferred on Dr. A. Hamilton Rice in recognition of his pioneer exploratory work in South America.

The Franklin Institute of the State of Pennsylvania acting through its committee on science and the arts, at its meeting on November 17, 1920, awarded to Dr. W. L. R. Emmet, of Schenectady, its Elliott Cresson Gold Medal. The wording of the award is as follows: "After a careful consideration and study of Dr. Emmet's work relating to ship propulsion, the institute is of the opinion that it deserves the highest award in its gift for the recognition of inventions of signal importance and awards to Dr. W. L. R. Emmet the Elliott Cresson Medal in recognition of his notable contributions to the art of ship propulsion!"

The gold medal of the British Institution of Mining and Metallurgy, has been awarded to Sir Thomas Kirke Rose "in recognition of his eminent services in the advancement of metallurgical scince, with special reference to the metallurgy of gold."

Sir William Beale has been elected president of the Mineralogical Society, London.

Dr. James M. Taylor, since 1873 professor of mathematics at Colgate University, has retired from active service.

Dr. John B. Watson has resigned from the professorship of psychology which he has held since 1908 at the Johns Hopkins University.

Dr. D. R. Hooker has resigned his position as associate professor of physiology in the Johns Hopkins Medical School, to engage entirely in research.

Professor C.-E. A. Winslow, of the Yale University School of Medicine, has been granted leave of absence for the spring term in order that he may assume the directorship of the public health activities of the League of Red Cross Societies at Geneva. Professor Winslow will return to New Haven for the opening of the fall term, October 1 next.

Dr. Robert K. Nabours, professor of zoology and experiment station zoologist in the

Kansas Agricultural College, has résumed his work, after a year's leave of absence, during which time he made a journey around the world pursuing investigations of the fur industry in various countries for Funsten Bros. and Company.

W. ARMSTRONG PRICE has resigned his position of paleontologist with the West Virginia Geological Survey and is now in Tampico as geologist with the Transcontinental Petroleum Company. He is accompanied by Lloyd C. Gibson, formerly geologist with the Seneca Hill Oil Company of West Virginia.

DR. HEBER D. CURTIS, director of the Allegheny Observatory, University of Pittsburgh, delivered the annual Sigma Xi lectures at the Universities of Kansas and Missouri, November 16 to 19. His general subject was, "Modern views of our sidereal universe." The first lecture was "The data of stellar evolution," and the second "The size of our universe."

DR. CARL J. WIGGERS, of the Western Reserve University, will deliver the fourth Harvey Society lecture at the New York Academy of Medicine, Saturday evening, December 11. His subject will be "The present status of cardio-dynamic studies on normal and pathological hearts."

DR. IVEY F. LEWIS, Miller professor of biology at the University of Virginia, made the address at the first public meeting of the newly formed Naturalists' Club of the University of Richmond, Va.

THE Huxley lecture was delivered in the Mason College, Birmingham, on November 26, by Professor C. S. Sherrington, whose subject was "The gateways of sense."

OWING to the continued ill-health of Mr. Spencer U. Pickering, which renders him unable to continue his experimental work at the Woburn Fruit Farm, which was carried on from 1894 to 1918 by the Duke of Bedford, and since then by means of a grant from the Development Fund administered by the committee of the Rothamsted Experimental Station, it is to be closed.

A NEW station for experimental biology has been founded at Schederlohe in the Isar valley, Bavaria, by Dr. Curt B. Haniel, with the collaboration of Dr. Jacob Seiler, formerly assistant of Dr. Goldschmidt, at the Kaiser-Wilhelm Institute für Biologie, Berlin-Dahlem.

THE American Mathematical Society will, as usual, hold two meetings in the Christmas holidays. At the annual meeting in New York on December 28–29 the election of officers will take place and President Frank Morley will deliver his retiring address, the subject of which is "Pleasant questions and wonderful effects." The regular western meeting, which is also the meeting of the Chicago Section, will be held at Chicago, on December 29–30, in affiliation with that of the American Association for the Advancement of Science. Professor Arnold Dresden, of the University of Wisconsin, is secretary of the western meeting.

PROFESSOR JAMES F. NORRIS has been elected to the chairmanship of the committee in charge of the C. M. Warren Fund of the American Academy of Arts and Sciences, in place of Professor H. P. Talbot, resigned. The income from the fund is available for the "encouragement and advancement of research in the science or field of chemistry," and may be used to provide the materials required for such investigations or assistance in their execution. The committee will be glad to receive and consider requests for grants from this fund. They should be addressed to Professor James F. Norris, Massachusetts Institute of Technology, Cambridge, Massachusetts.

WE learn from *Nature* that a meeting of the International Commission for Weather Telegraphy, which was appointed by the International Meteorological Conference at Paris in October, 1919, was held at the Air Ministry, London, during the week November 22–27. The following delegates were expected to attend the meeting: Lieutenant-Colonel E. Gold (president), Meteorological Office, Air Ministry; M. A. Angot, Bureau Central Météorologique, Paris; Colonel L. F. Blandy, controller of communications, Air Ministry; Dr. van Bemmelen, Meteorological Observatory, Batavia; Colonel Delcambre, Service

Météorologique Militaire, Paris; Professor F. Eredia, Ufficio Central di Meteorologia, Rome; Professor E. van Everdingen, Meteorologisch Institut, De Bilt, Holland; General Ferrié, Minister of War, Paris; Captain Franck, Service de la Navigation Aérienne, Paris; Señor José Galbis, Sericio Meteorologico Español, Madrid; Lieutenant H. D. Grant, Meteorological Office, Aor Ministry; Dr. Hesselberg, Meteorologiske Instituut, Christiana; Colonel Matteuzzi, Servizio Aerologico, Rome; Professor A. de Quervain, Central Meteorological Office, Zurich; M. Rey, Ministère de l'Agriculture, Paris; Captain C. Ryder, Meteorologische Institut, Copenhagen; Mr. T. Thorkelsson, Meteorological Service, Reykjavik; and Dr. A. Wallén, Meteorologiske Hydrografiske Anstalt, Stockholm. Since the war much progress has been made in different countries in the development of codes for telegraphic reports of the meteorological information which experience in the war and the needs of aerial navigation indicated as necessary. The main object of the commission is to coordinate these devlopments in the revision and extension of the codes prepared at the last meeting of the commission, which was held in London in September, 1912.

THE Civil Service Commission announces an examination for ordnance research engineer at $2,000 to $5,000 a year, or higher or lower salaries. It also announces an examination for junior physicist in the Bureau of Mines, at $1,500 to $1,800 a year.

AT the recent Chicago meeting of the American Mathematical Society the following resolution was passed: "The Society recommends for favorable consideration by the council applications for membership from advanced students and others interested in mathematics, whether engaged in teaching or not, when properly proposed by members of the Society."

DR. JONATHAN DWIGHT contributes the following note to the *Journal* of the New York Botanical Garden on the Linnaean Botanical Garden, at Upsala, Sweden: In the lower end of Svartbacksgatan at Upsala is the old botanical garden of Carl von Linné which has been nearly abandoned for about a century. This was the spot where the Flower-King spent most of his time among the plants, etc., where the grass throve and trees grew tall. The Egyptian Antiquities from the Victorian Museum have reposed there for some time in part in his hothouse and part in the Museum for Northern Antiquities. A change has of late taken place in the old garden. Some of the old trees have been cut down, the well cultivated lawns are elevated, and Linné's lily ponds (which are seen in old copperplate engravings of his "Hortus Upsaliensis") have been rebuilt in their location. The young men of the old Linnean Society have accomplished this change and renovation. Linné's greenhouse and the foreground have as yet not been restored. This fall, however, the Museum of Northern Antiquities will be moved to "Gustavianum" and then the house will be arranged for a Linnean Museum. Professor Svedelius informs the public that a large donation has been received by the Linnean Society for a new home for the director. As soon as it is ready the Linnean Society will take possession, and also of the Linné House, where the extensive collections of furniture, books, bric-a-brac, etc., which were the belongings of Linné will then be moved. The greater portion of these have been heretofore kept in the Linné house in Svartbacksgatan.

UNIVERSITY AND EDUCATIONAL NEWS

THE University of Cincinnati has received from the General Education Board of New York, an offer to contribute $700,000 to the Medical College. The gift is conditioned upon the raising of an additional $1,300,000 to complete the $2,000,000 endowment fund of the college; $900,000 of this amount has been subscribed.

WE learn from *Nature* that Professor James Mark Baldwin, formerly professor of psychology in the Johns Hopkins University, has offered to pay for the present, in honor of his friend, Professor Poulton, an annual sum of £100 into a fund to be called "The Edward

Bagnall Poulton Fund," to be applied at the discretion of the Hope professor of zoology at the University of Oxford, in the promotion of the study of evolution, organic and social. Professor Baldwin has also announced his intention of leaving by will money for the sustentation of such a fund.

DR. D. A. ROTHROCK, professor of mathematics, has been elected dean of the college of liberal arts of Indiana University.

PROFESSOR H. E. HAYDEN, JR., formerly associate professor of biology in the A. & M. College of Texas, is now professor of biology in the University of Richmond, Va. Mr. Paul R. Merriman has recently been added to the staff as associate professor of botany.

DR. JOHN STEPHENSON, until recently professor of zoology in Government College, Lahore, has been appointed lecturer in zoology in the University of Edinburgh.

DISCUSSION AND CORRESPONDENCE

POSITIVE RAY ANALYSIS OF MAGNESIUM

USING the apparatus for positive ray analysis described in *The Physical Review* for April, 1918, I have recently succeeded in analyzing the element magnesium (atomic weight 24.36) into three isotopes of atomic weights 24, 25 and 26. The method is an adaptation to positive rays of a method previously used for measuring the ratio of charge to mass for electrons. The three components of magnesium appear suddenly together as the magnesium anode is heated to vaporize slightly. Their masses may be compared accurately with the molecule of mass 28 due either to occluded nitrogen or carbon monoxide, which is driven off at lower temperatures. The method also gives the relative amounts of the rays; the components at 25 and 26 are of about equal intensity, and that at 24 approximately six times as strong as the others. The average atomic weight 24.375 agrees as closely as is to be expected in these first experiments with the chemical atomic weight.

A. G. DEMPSTER

RYERSON PHYSICAL LABORATORY,
UNIVERSITY OF CHICAGO

ON RECORDING APPARATUS FOR METEOROLOGICAL RESEARCH WITH ROCKETS

MR. S. P. FERGUSSON of the Weather Bureau has recently published several ingenious suggestions regarding the development of recording apparatus free from pivots, and hence useful in devices that are subject to jar. These suggestions are described in the *Monthly Weather Review* for June, 1920, pp. 321–322.

In this connection it is worth while remarking that tests with the model at present being made, using a mass carrying a recording pencil and held by a spring, show that the jar need at no time during the ascent be greater than would be experienced by a body striking the ground from a fall of 31 inches. This figure may be considered as representative of practical working conditons, but it is the jar, however, without any springs or shock-absorbing devices to protect the instruments.

Recording instruments for this particular work may be divided into two classes: First, instruments recording temperature, pressure and humidity by means other than the use of pivots, as already mentioned, the recording taking place both during ascent and descent. If records are to be had during the ascent, however, care must be taken so to support the various masses that there is no tendency to vibrate in a vertical plane. In general, this will not be a simple matter.

To the second class of instruments belong those involving the use of pivots which are kept separated from the bearings until automatically brought into contact when the descent begins, or at least after the propelling impulses have ceased. Instruments of this type need not differ fundamentally from devices at present in use, except that any considerable moments of force on delicate parts should be avoided.

R. H. GODDARD

CLARK COLLEGE

THE HISTORY OF SCIENCE SECTION AND THE PROGRESS OF SCIENCE

TO THE EDITOR OF SCIENCE: In view of the approaching meeting of the American Asso-

ciation for the Advancement of Science, to be held in Chicago on December 27 to January 1, with its anticipated large attendance of sections and affiliated scientific societies, it is desirable to call attention to the fact that a symposium of papers or conference upon the History of Science will be held.

It is desirable at this time, also to formulate some plan for reorganizing section "L" to be known in time as the History of Science section, and to receive the report of the executive committee of the Council of the Association relative to the original plan of the History of Science section, to whom application and letters of endorsement have been sent.

It is also an appropriate time for those interested in this field of research and study to give some expression for a more progressive and effective means of advancement, which can only be done by cooperation through a well organized section.

The idea of the formation of an organization of this sort has been in the minds of the students of the history of science for some few years. During the early part of 1919 a number of communications were published in SCIENCE[1] advocating the desirability of such a section, and, urgent as the communications were, no action was taken. However, the Executive Committee of the Council is quite ready to do all in its power to the furtherance of this movement, providing a sufficient demand is forthcoming. Therefore, it is greatly desired that all those interested in this proposed section, express themselves in some definite manner, preferably by being present at the symposium at the Chicago meeting.

From the very foundation of the Royal Society of London, in 1662, cooperation was the prevailing spirit; which gave strength and impetus to further scientific progress. Our own venerable institutions, namely: The American Philosophical Society and American Academy of Arts and Science, founded in the intellectual and scientific centers of Colonial life, were also imbued with the principle of cooperation, which laid the foundation of America's preeminence in science today. The National Research Council is in itself the highest spirit of cooperation. In fact, all scientific and literary societies realize the value of cooperation. It is, therefore, only too evident what note cooperation plays in the history of science, and the same idea must prevail in the study and research in the history.

Heretofore the development and encouragement of the study of the History of Science has been left solely to individual efforts, and much remains to be accomplished if the subject is to have the same relative standing as the study of physics, chemistry, astronomy and other divisions of the sciences. The question of a new section among the already large number of sections affiliated with the American Association for the Advancement of Science is not a cause for amazement—quite to the contrary, but one indicating a healthy state of intellectual growth—in science, and to the "Association."

That we need more historical background for our ever growing technical subjects is so apparent to scholars that no further recognition of this fact will be taken here. Nor do we need to dwell upon the place science occupies in the history of civilization. What we are interested in wholly at present is the subject itself, in the field of scholarship and the need for a more decisive impulse and sympathetic understanding.

In the spirit and faith of a modern Humanist, who says:[2]

> It is true that most men of letters, and, I am sorry to add, not a few scientists, know science only by its material achievements, but ignore its spirit and see neither its internal beauty nor the beauty it extracts continually from the bosom of nature. Now I would say that to find in the

[1] SCIENCE, N. S., Vol. XLI., March 5, 1915, pp. 358–360; Vol. XLIX., April 4, 1919, pp. 330–331; Vol. XLIX., May 9, 1919, pp. 447–448; Vol. XLIX., May 9, 1919, pp. 447–448; Vol. XLIX., May 23, 1919, p. 497; Vol. XLIX., July 18, 1919, pp. 66–68.

[2] Dr. George Sarton, "The Faith of a Humanist," *Isis*, No. 7, Tome III., January, 1920, p. 5.

works of science of the past, that which is not and can not be superseded, is perhaps the most important part of our own quest. A true humanist must know the life of science as he knows the life of art and the life of religion.

The life of a science is not its daily practise in technic, building theories, testing hypotheses and handling results as worth so much—it is the story of trials and errors—the struggle of the mind for new concepts of nature and man's relation to this progress, and in the words of another true humanist,[3]

> The student should be led to see that human history is a continuous process, not a succession of catastrophies. The real growth of humanity takes place in quiet; by war it is interrupted or reversed. For war is never the motive force of progress, and the spread of great ideas is not often facilitated by it. The forward trend of civilization is largely conditioned on science—itself a product of peace.

With each new advance in science, each phenomenon of event shows only too conclusively how closely knit is the history of the discovery bound up with it, that no discussion of the theory or final result can be clear without its antecedent proceeding. The evolution of scientific progress clearly shows that there is no finality in science. The recent work in "Relativity and Gravitation" is the best example of concomitancy of theory and history—from the philosophical concept of the Greeks, to the present most rigorous and complex mathematical and physical understanding of Einstein's theory. The whole field of physical science has been reset with historical importance which has never been realized since Newton.

And surely our own progress in science in America warrants us to become more introspective, namely—viewing the present in the light of the past. If we are to have a distinct type of culture, worthy of any great intellectual epoch, it must depend upon our ability for introspection. To this end, then, it is interesting to note, that throughout the country there is awakening a new interest in the history of science. This movement is but natural and in conformity with the growth of science progress itself.

Some few years ago it was pointed out to what extent the interest in the history of science had grown, especially as an educational factor in our colleges and universities.[4] Fortunately the "great war" has not lessened the interest, but it may have retarded the developments.

From a recent survey over practically the same field of investigation, it is extremely encouraging to note a few prominent features of this development. These facts will be given in order that a clearer understanding may be had for one of the many reasons why the History of Science work should be organized to form section "L" (Historical and Philological Sciences). Heretofore section "L" has not functioned, so that the field is open for organization and for productivity.

The most prominent and effective step in this growing movement was the establishment of a full professorship at the University of California in 1918 in the history of mathematics. The well-known scholar and historian of mathematics, Dr. Florian Cajori, has for two years offered courses in the history of mathematics and history of physics, besides for graduate work two seminar courses are offered in the history of algebra and of infinite series.

The next forward step of equal importance was the establishment of the post of research scholar in the history of science in the Carnegie Institution of Washington. The new position (Associate in the History of Science) was eminently filled by the appointment of Dr. George Sarton, who has for the last few years been offering courses in the history of science in Harvard University. From an extract concerning Dr. Sarton's work[5] it is of value to note the importance the authorities of the Carnegie Institution place upon the future of this movement.

[3] David Starr Jordan, "Building for the Future," *The Public*, May 3, 1919, p. 462.

[4] SCIENCE, N. S., Vol. XLII., No. 1091, pages 746–760, November 26, 1915.

[5] Year Book No. 18, Carnegie Institution, Washington, D. C. (1919), pages 347–349.

In recognition of the fact that the progress of astronomy in America has made magnificent contributions to that science, it is befitting that we should find in the oldest school for astronomical graduate work a course pertaining to the history of astronomy in America. The Detroit Observatory of the University of Michigan has in itself a wonderful history, in respect to training astronomers who have all been leaders in astronomical research. Dr. W. Carl Rufus's work in the history of astronomy consists of two courses—the first being the general history of astronomy and the second following with the history of astronomy in America. The second course is of particular interest to us now, since it is building the framework upon which the history of science in America must rest.

A cooperative course in the history of science is now being offered for the first time at the Northwestern University. It is given in two divisions, namely: the history of the physical sciences, given by Dr. Henry Crew, and the history of the biological sciences, by Dr. William A. Locy.

We may venture here to state that this form or division of the history of science teaching is probably the most satisfactory form in which to conduct the whole subject, since it is becoming more apparent that no single individual will be able to teach the subject as a whole.

At the University of Chicago we find a rather unique institution in the form of two historical courses being offered in the correspondence-study department by Dr. G. W. Myers. The history of mathematics and the history of astronomy are given primarily with emphasis placed upon the cultural value. Aside from the regular established course in the history of mathematics and biology, and a new course being offered in the history of astronomy, Yale University has announced a series of public lectures in the history of science.[6] These lectures clearly emphasize this growing movement for a more sympathetic understanding of the past, a regard for the past human relationship of those whose labors have prepared the way.

And, finally, it is to be accepted as a recognition of the worth and importance of the history of science when we read of the successful conference the American Historical Association carried on in December, 1919.[7] The interest the historian of the social and political sciences has in the history of science, is decidedly different from the historian of the sciences themselves. One may be termed the cultural interest, whereas the other is the technical interest. That is, the former is interested in the history of science from the point of view of methodology and the influence science has had on civilization—the latter is mainly concerned in the development of the concepts in science, and the growth of the subject matter and its influence upon related problems. It is evident that the interest can be, with profit, fostered by two widely different organizations, which never meet in common.

Such has been the progress of the movement to cultivate the history of science in the United States within the last few years. The remarks concerning these various steps of the progress are necessarily brief, but sufficient has been quoted to indicate that a new cultural epoch in the intellectual history of America is dawning. This cultural epoch must, from the very fact of its influence and interpretation, come to be known as the "new Humanism."

FREDERICK E. BRASCH
THE JOHN CRERAR LIBRARY,
CHICAGO, ILL.

SPECIAL ARTICLES

OPTIMUM NUTRIENT SOLUTIONS FOR PLANTS

DURING recent years numerous investigators have devoted considerable time and resources to the study of the salt requirements of various plants. Plans have been proposed for the extension of this work, with the hope that certain fundamental data may be obtained which shall indicate the composition and concentra-

[6] SCIENCE, N. S., Vol. LII., No. 1347, p. 383–384, October 22, 1920.

[7] SCIENCE, N. S., Vol. LI., No. 1312, pages 193–194, February 20, 1920.

tion of the solution or solutions best suited to the growth of the plant. It now seems to be an opportune time to raise the following questions: first, is it probable that the plant has any definite response within broad limits, to a particular ratio of salts or ions contained in the complete nutrient solution; and second, assuming the existence of such optimum solutions, are the methods generally employed adequate to determine their composition?

With regard to the second point, in a previous communication the writer[1] has attempted to show that in many experiments the total supply of nutrients may have limited the yield of crop, rather than the salt proportion. In another article[2] it is shown that insufficient attention has been given to the possible limitation on growth with certain solutions, due to the insolubility of iron, when this element is added in the form of the phosphate. Recent work by Waynick[3] and Davis[4] has emphasized the necessity for interpreting the data obtained in plant culture experiments with due consideration given to the variability of plants. In the majority of previous experiments this question has been almost completely overlooked.

During the course of an investigation on certain phases of plant nutrition, an incidental experiment has been carried out which may be suggestive in connection with the first point mentioned in this note. Three series of nutrient solutions were prepared:[5]

(*a*) Solution used by the author.
(*b*) Shive's best solution, R_5C_2.
(*c*) Shive's solution diluted to 1/3 of its concentration in *b*.

In each case 15 barley plants were grown for six weeks under favorable and uniform conditions of sunlight. The containers were of one liter capacity and only one plant was grown in each bottle. The solutions were changed weekly. Thus the total volume of solution provided for each plant was considerably larger than that used in most experiments of this type. Iron tartrate was added twice each week to all cultures. All the plants grew at a uniform rate and there was no apparent difference between the three sets at any time. The initial composition of the three solutions and the weights of the plants air dried were as follows:

Solution	Composition of Nutrient Solutions							Data on Plants				
	K, PPM.	Ca, PPM.	Mg, PPM.	PO_4, PPM.	NO_3, PPM.	SO_4, PPM.	Total Concentration, PPM.	Total Weight Tops, Gms.	Total Weight Roots, Gms.	Average Length Tops, Cm.	Average Length Roots, Cm.	Ratio Tops / Roots
a. (Author)	190	172	52	117	700	202	1,433	48.9±7.5	8.4 ± 1.5	45 ± 3	30 ± 5	5.8
b. (Shive R_5C_2)	710	250	372	1,766	750	1,489	5,337	48.6±8.5	7.8 ± 1.5	48 ± 3	26 ± 2	6.2
c. (Shive R_5C_2) ⅓....	237	83	124	588	250	496	1,779	39.0±4.5	7.4 ± 1.5	45 ± 3	25 ± 4	5.3

It is evident that solutions *a* and *b* produced equally favorable growth within the limits of error of this experiment, while the smaller yield from *c* is not necessarily significant, although in this case it is possible that the total supply of nitrate was insufficient. Thus in this experiment (a number of other experiments not now reported lead to the same conclusion) solutions of radically different concentrations and salt proportions have not affected the yield of the crop to any important extent. There is, however, no intention to give the impression that certain solutions (possibly including those containing large proportions of magnesium salts) may not inhibit plant growth because of unfavorable physiological balance. The point which

[1] D. R. Hoagland, SCIENCE, N. S., Vol. XLIX., pp. 360–362 (1919).

[2] D. R. Hoagland, *Jour. Agr. Res.*, Vol. XVIII., pp. 73–117 (1919).

[3] D. D. Waynick, Ann. Rep. College of Agr., University of California, 1918–19, p. 67.

[4] A. R. Davis, Univ. of Calif. Pub. in Agr. Sci. (in press).

[5] J. W. Shive, Phys. Researches, Vol. 1, pp. 327–397 (1915).

it is desired to make is that the range of equally favorable ratios between nutrient salts is probably a very broad one, no doubt including the solutions of most soils. This is not a surprising conclusion in view of the observation that under proper climatic conditions many different types of plants can grow vigorously on any fertile soil, while a given type of plant may grow equally well on various soils, the extracts of which have entirely different proportions of nutrients. Again, plants of equal development may store nutrient elements in very different ratios, when grown in different soils or solutions.

It has sometimes been suggested that solution and sand culture experiments offer a fundamental means of determining fertilizer requirements of soils, in connection with a proper physiological balance for the plant. If one considers the dynamic nature of the soil system, with its constantly fluctuating soil solution and the reactive properties of the soil minerals, it seems scarcely within the limits of possibility to alter a soil solution to fit any particular ratio of nutrients. The addition of any one fertilizer salt may affect all the various components of the soil solution. Moreover, many elements are present in the soil solution besides those added to the artificial culture solutions and it may not be assumed that these are without effect on the physiological balance of the solution, if indeed such a balance is of importance ordinarily.

D. R. Hoagland

Division of Agricultural Chemistry,
University of California

THE AMERICAN CHEMICAL SOCIETY, CHICAGO MEETING

The 60th meeting of the American Chemical Society was held in Chicago, Ill., Monday, September 6, to Friday, September 10, 1920. The council meeting was held on the 6th and a general meeting on September 7th, in the morning at the Congress Hotel, Chicago, and in the afternoon at Northwestern University, Evanston. Divisional meetings were held all Wednesday morning and all day Thursday, and excursions Wednesday afternoon and Friday. Full details of the meeting and program will be found in the October issue of the *Journal of Industrial and Engineering Chemistry*. The registration was one thousand three hundred and eight.

The combined outdoor and indoor entertainment on the campus of Northwestern University on Tuesday afternoon was a new feature which met the hearty approval of all as it offered both a varied entertainment to the members and special opportunity for becoming acquainted.

General public addresses were given by Thomas E. Wilson, president, Wilson & Co., on "The value of technical training in the reconstruction of industries," and by Professor A. S. Loevenhart, head of the department of pharmacology of the University of Wisconsin, on "Chemistry's contribution to the life sciences." The chief public address was the president's annual address given by Dr. W. A. Noyes, in the Gold Room of the Congress Hotel, and was entitled, "Chemical publications." General addresses on Tuesday afternoon were given by H. P. Talbot on "Relation of educational institutions to the industries," and by W. A. Patrick on "Some uses of silica gels." The banquet, held on Thursday evening, September 9, filled the Gold Room of the Congress Hotel to overflowing. At the general opening session Charles L. Parsons reported on the International Conference of Pure and Applied Chemistry held in Rome, June 22 to 25, of which he was vice-president and to which he was a delegate from the American Chemical Society.

Abstracts of a larger part of this paper presented follows:

DIVISION OF BIOLOGICAL CHEMISTRY

R. A. Gortner, *chairman*,

A. W. Dox, *secretary*

Diet and sex as factors in creatinuria in man: Howard B. Lewis and Genevieve Stearns. There appears to be no direct relation between the phases of the menstrual cycle and the appearance of creatine in the urine of the normal adult female. Protein *per se* is not a causal factor in the production of creatinuria and there is no more tendency toward the production of creatinuria by high protein diets during the menstrual than in the intermenstrual periods. The retention of creatine ingested *per os* by women does not differ markedly from that by men.

The nutritive value of the proteins of tomato seed: CARL O. JOHNS and A. J. FINKS. Nutrition experiments with albino rats have shown that normal growth can be obtained when the sole source of protein in a diet is furnished by tomato seed press cake. The protein content of the diet was approximately 18 per cent. and it was made adequate with respect to the non-protein dietary constituents.

Hydrolysis of the globulin of the coconut, Cocos Nucifera: D. BREESE JONES and CARL O. JOHNS. The globulin of the coconut has been hydrolyzed, and the resulting amino acids determined. By changing the order of procedure usually followed in connection with protein hydrolysis, and by applying several rather recently described methods, 78.15 per cent. of the hydrolysis products of the protein used has been identified and determined. The order of procedure followed in the isolation and determination of the amino acids was as follows: removal of the hexone bases with phosphotungstic acid: separation of most of the glutaminic acid as the hydrochloride: precipitation of the remaining dibasic amino acids as their calcium salts: extraction of proline and peptide anhydrides with absolute alcohol; esterfication of the remaining amino acids by means of the lead salt method of F. W. Foreman: fractional distillation of the esters under reduced pressure, and finally, regeneration and isolation of the amino acids in the usual manner.

The globulin of the cohune nut, Attalea Cohune: CARL O. JOHNS and C. E. F. GERSDORFF. The globulin has been extracted and analyzed. Its analysis reveals a similarity to that of the coconut globulin. Like the coconut globulin it contains relatively high percentages of arginine and lysine, one half of the latter as determined by the Van Slyke method agrees fairly well with the free amino nitrogen of the protein. The globulin gives a strong test for tryptophane. A trace of albumin has been shown to be present.

Some proteins from the mung bean, Phaseolus Aureus (Roxburgh): C. O. JOHNS and H. C. WATERMAN. The Mung bean contains about 21.74 per cent. of protein (N $\times$ 6.25). Experiments with sodium chloride in various concentrations indicated a 5 per cent. solution as the most effective extractant; it dissolved 19.0 per cent. of protein from the finely ground seed. The saline extract yielded two globulins, designated the α- and β-globulins, by fractional precipitation with ammonium sulfate and by subsequent purification of the fractions as described. The yields were 0.35 per cent. and 5.75 per cent., respectively, of the dry material extracted. Traces of an albumin, also, were obtained from extracts from which all the globulin had been precipitated by prolonged and repeated dialysis. The albumin remained in solution during the dialysis and was separated by slightly acidifying and coagulating at 45° C. The yield was from 0.02 to 0.05 per cent. of the bean meal. Analyses showed marked differences in the nitrogen- and sulfur-content of the three proteins. The globulins were still further distinguished from each other by considerable differences in their percentages of the basic amino-acids, determined by Van Slyke's method. The β-globulin contained so little cystine that remaining undecomposed after hydrolysis escaped precipitation by phosphotungstic acid and could not be determined by Van Slyke's method.

The effect of the fat-soluble vitamine content of a feed on the fat-soluble vitamine content of adipose tissue: J. S. HUGHES. The high fat-soluble vitamine content of beef fat as compared to lard has been explained on the grounds that the ordinary feeds used for steers contain more of this vitamine than the feed usually used for hogs. This explanation implies the assumption that the fat-soluble vitamine content of the tissue can be changed by varying the content of this vitamine in the feed. In order to secure some experimental data on this subject, a number of animals including rabbits, hogs, dogs, hens and ducks were fattened on feed both high and low in the fat-soluble vitamine content. The adipose tissues from these animals were rendered, care being taken not to allow the temperature to go much above the melting point of the fats. The relative fat-soluble vitamine content of the fat from each animal was determined by using it as the only source of this vitamine in an otherwise adequate diet. In no case did the results indicate that the fat-soluble vitamine content of the adipose tissue could be increased by increasing the amount of this vitamine in the feed.

Further studies upon the local anesthetic and antiseptic action of saligenin and its mercury derivatives and allied compounds: ARTHUR D. HIRSCHFELDER, MERRILL C. HART, and F. J. KUCERA. Strong solutions of saligenin can be used as a local anesthetic in cystoscopy and dilatation of the male and female urethra. Saligenin is a mild antiseptic and is an analgesic in chronic

arthritides, but we have not found any chemotherapeutic action against trypanosomes or spirochaetes. A di-mercury compound of saligenin has been prepared by refluxing saligenin with 2 mols. of mercuric acetate in dilute alcohol on a water bath for several hours. The sodium salt of this is water soluble and is an excellent antiseptic, about as good as $HgCl_2$ but 1:1000 solutions are non-irritating to mucous membranes, and are being used successfully in the treatment of gonorrheal urethritis. An acetate of this substance has also been prepared.

The occurrence of diastase in the sweet potato in relation to the production of sweet potato sirup: H. C. Gore. In the production of sweet potato sirup the potatoes are cooked until soft, crushed finely and mixed with 2 parts of water. Three per cent. of ground barley malt is then added, and the mixture digested at 60°–65° C. for from 20 minutes to one hour. During the time nearly all of the starch is changed into maltose and dextrin. Separation of the soluble solids from the insoluble pulp is easily made by use of the rack and cloth type of press or by suction filtration; and the wort is then evaporated into sirup. The yield of sirup is at least 30 per cent. of the weight of potatoes taken. The pulp remaining amounts to 5 per cent. of the weight of potatoes, and may be dried and used for feed. The crude sirup can be used for all cooking purposes for which similar sirups are employed.

Polyneuritis as influenced by the amount of protein and carbohydrate present: A. D. Emmett.

The acid-base balance in animal nutrition. IV. The tolerance of rabbits to acid rations over long periods of time: A. R. Lamb. Rations complete from the standpoint of nutrition and as nearly as possible of proper physical character for rabbits were so planned from combinations of oats, alfalfa meal, casein and normal sulfuric acid solution, as to furnish a slight excess of acid-forming mineral elements. This excess of acid in the ration was equivalent to about 3 to 5 cc. normal acid solution per rabbit per day. On this ration several rabbits have made normal growth, and one female which has received the ration for eleven months has reproduced successfully, and her progeny have made their entire growth to maturity on the same ration. Most of the acid is excreted normally as phosphates. The ammonia production in the second generation, however, is increased from an average of 0.5 per cent. of the total urinary nitrogen to an average of 2.0 per cent. on the same ration, a possible adaptation to the abnormal acid character of the ration. This work is being continued.

Further studies on the effect of a deficiency of fat-soluble vitamine: V. E. Nelson and Alvin R. Lamb. Rabbits fed upon a ration of casein, dextrin, salts, wheat embryo and extracted alfalfa, containing practically no fat-soluble vitamine but otherwise complete, invariably develop xerophthalmia. The time of the onset of this symptom varies directly with the age of the rabbit and occurs in young rabbits in four to eight weeks time. A ration consisting of oats, gelatin, salts and extracted alfalfa produced from three to eight weeks before the death of the rabbit. Attempts to induce the disease in the eyes of rats on the same ration by inoculating with the exudate from the eyes of affected rabbits did not succeed. It has not yet been possible to produce the disease in chickens or guinea pigs.

The hydrogen ion concentration of the contents of the small intestine: J. F. McClendon. Determinations were made on two healthy men about 25 years of age on a mixed diet and the following readings obtained: Subject No. 1, pH = 5.1, 4.5, 4.9, 4.1, 4.2, 6.5, average 4.9; subject no. 2, pH = 4.5, 5.2, 4.4, 6.2, 6.4, 5.9, average 5.4. The determinations were made by passing a rubber tube, 1.5 mm. bore with 6 gram weight attached through the mouth until it extended 7 feet into the alimentary canal. The tube was allowed to remain in place 5 days and 4 nights while the subjects followed their accustomed occupations. The contents passed out of the tube into a hydrogen electrode vessel. The electrode was made of gold, plated with irridium and was totally immersed in the sample when the readings were taken.

Charles L. Parsons,
Secretary

(To be continued)

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, DECEMBER 17, 1920

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE ANTHROPOLOGICAL PROBLEMS OF THE FAR EAST[1]

THE white man is quite liable to forget that the Far East is a very great part of the world; that it is, in fact, a more populous and greater world than his, and one which has perhaps quite as many and important problems of its own. But it is difficult to realize these things unless the student actually visits the Far East, and by Far East I mean the entire eastern half or rather two thirds of the Asiatic continent with the adjacent oceans. Once you enter these territories you are in a vast human beehive; you see on all sides of you peoples of interest; peoples who must have their history, their antiquity; peoples who must have many problems the solution of which is connected with and would be of value to the rest of the world. When, as an anthropologist, you have been in these regions for a length of time, you begin to see a light, very dim at first, which shows you these problems, so far as our own field is concerned, are divisible into two large classes: into the more *comprehensive* ones, which involve very large groups of humanity and the large questions, and into the more *particular problems,* which are proper to the different individual ethnic groups that occupy those territories.

I shall speak first of all of some of the more individual problems, but it may as well be stated at once that with these or the larger problems I shall not be able to do more than to present mere outlines for your contemplation; more thorough definitions and the answers to the problems are matters for the future.

It will be handiest to take up the particular questions geographically, and begin with the north or rather the northeast. And here we

[1] Lecture delivered before the 548th meeting of the Anthropological Society of Washington, October 19, 1920.

encounter first a fairly large group of people who present physical and other features that in many respects ally them closely with the American Eskimo. They are the Chukchee and related tribes. Those who have seen living representatives of these people, or only their portraits, and who at the same time know our Eskimo, could not but have been struck forcibly with not merely the close resemblance, but the physiognomic and general physical identity of the two groups. But what is the real connection between them we do not know. It would of course be easy to jump over the bridge and say that both people sprang from the same stock, but that would be an opinion, not a demonstration. We know that in early historic times the Asiatic "Eskimo" traveled over the Behring Straits on to the St. Lawrence Island and probably to the American side of the straits; and we also know that some Eskimo from this side traveled in the opposite direction, but that does not yet establish their identity. A good deal of creditable work has been done on the Chukchee by Russian scientists, but the actual determination of the main facts is still in abeyance and the whole constitutes one of the attractive problems of anthropology for the future.

Another interesting ethnic group in the Far East about which we know but little, even less than about the Siberian "Eskimo," are the natives of Kamchatka. They are not so much like the Eskimo, although we find amongst them individuals who approach Eskimo physiognomy more or less; but one may perceive among them again and again the physiognomy or an approach to the physiognomy of the American Indian. Recently a Swedish expedition with, as reported, ample means and intending to stay in the field for at least two years, has proceeded to the peninsula with the object of studying the people as thoroughly as possible; but the group should be and will probably have to be studied as well by Americans who are well acquainted with the Indian.

As we proceed farther south we come to another interesting group of people now almost extinct, which however to this day presents its problem to anthropology, and these are the Aino. It is often supposed that the Aino are native to little more than the island of Yezo in Japan, but that is an incorrect localization. They occupy to this day parts of the Kuriles Islands and Saghalien, and they occupied in early historic and prehistoric times the entire Japanese archipelago, excepting perhaps the southernmost portions. Here are people who differ considerably in their physique from both the Chukchee and the more Indian-like people of the Kamchatka peninsula. They evidently have in them a considerable mixture of white blood; in addition to which they unquestionably have also a proportion of yellow-brown, the stock which now prevails over all these regions. It is known that they occupied the Japanese archipelago before the Japanese reached that country, though they may not have been there very long: and there are some indications that their inflow into Japan may have been from the north. But all this is still problematical, together with their influence on the actual Japanese, and calls for further investigation.

Another interesting group or rather conglomerate of people in the north of the Far East, are the Tunghuz. These can no more be regarded as a single tribe. They embrace, from the physical standpoint at least, people of decided differences. The Tunghuz of the south are unlike the Tunghuz of the north. The southern Tunghuz, or at least certain groups of them, resemble the American Indian so much that the student can not but be struck most forcibly by the fact. It is such a resemblance, in color, physiognomy and all features of the body, that we can not but feel there must be here an identity of stock, and a unity in perhaps not a very far distant past. These tribes are now in their decline, and they are crying for a thorough investigation from every anthropological standpoint. True, there are some Russian accounts of them, but they are only partial, insufficient. It would seem self-evident that in a case of such important disappearing people we should have casts as well as plenty of photographs and

measurements in order to preserve the characteristics of the group to science and history, for in another generation or two they will be completely mixed up and extinct. They are going rapidly like many of our American tribes and unless promptly studied we shall before many years long in vain for satisfactory records. Here is a problem which calls for immediate attention, a problem of much more than a local or even only Asiatic interest, something indispensable to American anthropology; and one remembers with pity the recent resolutions relating to the problems of the Pacific made at the Congress of Hawaii, among which questions like this were wholly forgotten.

A little farther south, we come to still another interesting and important group, in the process too of becoming anthropologically spoiled by amalgamation—the Mongolians. The term "Mongol" applied to many of the Asiatic peoples is of course a misnomer, much as when we call all white people "Caucasian" or "Aryan." The Mongolian people who extend over a large region to the south of Lake Baikal, and admixture with whom is very evident in some parts of China, are, like the Koriaks and the Tunghuz, remarkable for the frequent occurrences among them of types that resemble, and at times resemble to the point of identity, the American Indian. Besides this, you will find among the Mongolians not a few indications of admixture with white people. You will find, especially in the western part of the territory, individuals with blue eyes and brown hair and white skin. And in southern Mongolia the people have become mixed with other branches of the yellow-browns that do not so much resemble the American Indian. Here surely is a stock that calls for investigation, not merely physically but also linguistically and in other directions. They speak five chief dialects or languages; they sing songs that are purely Indian in sound and character, and they do many things like the Indian. One night, being absorbed in my work, and hearing a Mongolian pass, singing as he went, I just simply became confused; it seemed I must be somewhere in America amongst the Indian tribes. Whether the words were alike I do not know, but the sounds were identical. They are like the Indians in many habits—for instance, you will find piles of rocks in the mountain passes accumulated through ages by the traveling Mongols, precisely as you may see in parts of our Sierras where they have been piled up by the Indians; and they do exactly as the Indian does when he reaches the summit of the pass—they take up a pebble, offer a short prayer, spit on the stone, pass it over their legs, return thanks that they have reached the summit, and pray that they may reach the end of their journey in good strength and safety. This is exactly what the Pueblo Indian does in our southwest, or the Peruvian Indian in the Andes. And this is but one instance out of many such resemblances between the Mongolian and the American Indian. They extend to personal and even religious observances, notwithstanding the fact that the Mongols have long been converted to Lamaism, one of the most exacting and intolerant of religions. So here again there is a series of problems which urgently calls for investigation, and they are problems connecting directly with the American, and hence calling for the student well acquainted with the American Indian.

We come now to the more cultured and better known groups of the Japanese, Koreans, Chinese, Indo-Chinese, Burmese, Hindu, etc., and every one of these groups teems with problems that need investigation.

Take Japan for instance. To this day the origin of the Japanese people is in considerable haze. It is supposed that their main line of ancestors, in all probability of mixed Tunghuz derivation, came about 1,000 years B.C. or a little over, from somewhere in eastern or northeastern Manchuria, and very likely also southeastern Siberia. But it is also perceptible in Japan, especially among the female children, that there has been some infusion of an Eskimo-like type. In all probability the "Tunghuz" carried with them some elements of the Asiatic Eskimo. You may find little girls in the streets of Tokyo

to-day who have perfect Eskimo features, and you will find this feature occasionally in the adults as well. The Japanese know it, but whether they are not willing to admit it, or simply have not pronounced themselves upon this point, they have never offered any explanation. It seems that the invading stream was derived from a large part of the northeastern region, that after passing around or through Korea they reached the main island of Japan, settled then by the Aino, and that possessing better military art and weapons, they prevailed over the Aino partly by uniting with them and absorbing them, and partly by destruction. The Aino have survived only in the north, and to-day not only are they few in number but it is practically impossible to find a full-blood among them. But this was by no means all of the origin of the Japanese. Before even the Aino came, there apparently was in the southern portion of the islands a neolithic population. The Japanese collections contain now some skeletal remains of these people, and these show that even then there was already a diversity, though the general type is that of a yellow-brown people, who must have penetrated into southern Japan at that time from Korea or the continent. And there is another element, not traceable so far historically, that apparently came from the south. Whether it came from Formosa, or from the Chinese coast or even from the Philippine Islands is not known, but some facts would point to the Philippines rather than to Formosa. This southern element is responsible for bringing into Japan certain cultural features, and physically a few traces of the Negrito. To this day you will find Japanese—rarely yet occasionally—who bear physical traces of negrito admixture. They are it seems ashamed of it. The Japanese anthropologists are aware of the fact, but it has received no further attention. In addition there was a more important influx of Chinese and Koreans, and also since early in historical times there was a slight influence of whites. Just what part these different elements played in the building up of the Japanese people remains to be determined. Also, there are still many old mounds and sites in Japan that demand careful exploration. The Japanese anthropologists are slowly working in these directions, but they must necessarily lack the perspective that could be brought to the field by the American student. For this and other reasons it would be better if scientists from this continent as well as from other parts of the world would participate in the work.

The Koreans too, present a field for much further research. Though yellow-browns, they are a distinct people from both the Japanese and Chinese. They resemble greatly some of the more western Russian Tartars. The Japanese in general, for political reasons, are rather anxious to convince the Koreans as well as others, that the Koreans are the same as themselves, but the scientific observer sees readily substantial differences, at least as large as are those between the Koreans and Chinese.

In China itself there are still many problems for anthropological investigation. In the first place is the origin of the great Chinese people, counting to-day between three and four hundred million individuals. We know that their ancestors came from somewhere in the northwest; that they mixed with people already in the country, the so-called wild tribes and others; that later they impinged upon and perhaps mixed slightly with the Negritos of the south. But none of this is as yet fully cleared or established, and there are many other questions. There are in southwestern China groups some of whom are not yellow-brown but rather Indonesian or of Hindu derivation, much nearer to white people than the Chinese. We find also considerable physical and other differences between the Chinese of the north and the Chinese of the south. These remain to be investigated. There are large districts where there are remains in the nature of mounds, or burial caves, or sites, which have hardly yet been touched. Also there are unknown tribes in the western mountains. Some of these tribes have been mentioned by explorers, but none have been investigated anthropo-

logically, and what is true of the western part of China is even more true of the neighboring Tibet. The southern portions of Tibet are the least desirable anthropologically because they are the most mixed, and they have been investigated to a certain extent by the English. The real Tibetans live more in the center and towards the northeast of the great region, and among them again one finds the physiognomy of the American Indian.

South of China are masses of mixed population; but there is one prevailing group that needs careful attention, and that is the Malays. These people are found in Borneo, in Java and the rest of the Malay Archipelago, in the Philippines and elsewhere, besides on the continent, and we still lack a knowledge of them which would enable us to say precisely what they represent, and which would enable us to join them more directly to other branches of the yellow-brown people.

Here in the south we find too one of the most enigmatic of all the now existing groups of humanity, namely the Negrito. There are indications that at one time the Negrito occupied a very much larger territory than he occupies to-day, that he was in other words a much more important anthropological group than he seems to be now. There are to this day Negrito settlements in the little islands off the southeast of Formosa; there are traces of them in southern China, and more in Burma and Indo-China; they people the Andaman and the Nicobar Islands off the coast of India, and there is a large remnant of them in the Philippine Islands, especially on the island of Luzon. But they, or traces of them, exist also in New Guinea, and in many of the islands of Micronesia, Melanesia and even Polynesia. Therefore the opinion is justified that the Negrito at one time, before and during the influx of stronger peoples from the northwest, played an important part in the peopling of Asia. But we still do not know just where to place the Negrito. Is he allied to the African Pygmy? or is he a separate development? That he has some connection with the Negro is certain, but how can this connection be explained? And when and whence has he reached the territories he peopled? If any human group should be thoroughly known, it is surely the Negrito; but he is receiving nowhere near the attention that he deserves. Here again there is a fertile field for investigation.

As we proceed eastward we now approach the great group of Polynesians. This is the particular group that is just now receiving so much attention; but I am afraid that some of this attention will be misplaced, for it can not lead to any great results. In the first place it is well known that the peopling of Polynesia is quite recent; in the second place nothing has ever been found on all these islands that would justify a belief in anything more ancient. Furthermore, and this is perhaps the most important, any one who has had any direct acquaintance with the Polynesians must readily have recognized that they are a mixed people. There are individuals among them who resemble more or less the American Indian, while others represent more the Malayan type of yellow-browns; there are those who clearly approach the white man; and there are numerous individuals who bear traces of the Negrito or Negro. Now, a mixed population of this nature, and of recent historical derivation, can not yield a great deal to anthropological research. There are undoubtedly problems of interest in the study of the Polynesians, but when we contrast them with those of the rest of the Far East, we can not but perceive that the Polynesian problems have not a primary importance.

A more important set of problems are those relating to Australia. We have heard much about the "Australian race," but it is very doubtful if there is any such thing as an Australian *race*. If we compare the natives of one part of Australia with the natives of other parts, we see such differences that physical unity can scarcely be contemplated. They have of course been territorially circumscribed and they have intermixed; they have numerous customs in common, though they also differ in this respect; but they are probably not one people. They have commonly been talked of as "the Australian"; they should rather be dealt with as the "Australians." The anthro-

pologists have further sinned against the Australians by classing them as but little higher than the anthropoid apes. Because some of them present various primitive features, such as marked supraorbital ridges or pronounced prognathism, they have been placed on the lowest rung of the human scale. This is not yet fully justified. The Australian demands a lot of new careful, unbiased investigation, and he demands it urgently for he also is disappearing—not by amalgamation, although that also exists in some parts—but through habits and diseases introduced by the white man.

From Australia there is but a step to Melanesia, which too, presents its problems; the main one being perhaps the advent into these regions of the African Negro. Most if not all the groups show individuals who are regular types of the African Negro in physiognomy, character of the hair, stature and all other respects. This is a big negro, not the small Negrito who was evidently always small and whose diminished stature with slender limbs has made him conspicuous even in admixtures. The type represented here, aside perhaps of some Negrito, is the real African. But how did Africans come into these far away islands? They never were navigators of any note. Were they brought there by others, perhaps the Egyptians or the Arabs? We do not know as yet. It is another problem of the Pacific. And there are others in Melanesia.

Then there are the many problems of the people of the Indies. As yet we do not know exactly what the Indian populations represent, or just how and when they came. There was a stream of "Aryans," but who were they? And just who anthropologically are the Dravidians, the Ceylon Vedahs and the other groups of importance? We see on one hand a large Mediterranean strain. There are many people in India who, if placed in a more northern climate for a few years, would so closely resemble the southern Italian that they could not be told apart. There are other Hindu who resemble the people of Afghanistan, or those of Persia, southeastern Russia, and perhaps even the Nordics of Europe. Again there are undoubted and numerous semitic elements, and then of course there are the mixtures of the Malays and other yellow-browns, and those of the Negrito. Here are many problems that await and deserve a careful further anthropological investigation.

So much in a very superficial way about the more *particular* problems of the Far East and the Pacific. There are plenty of them and they claim our special attention because as Americans we are directly interested in the eastern Asia which gave us our Indian. But these parts of the world present some greater, more *comprehensive* problems of the most stimulating and absorbing interest, which can not be solved fully before many of the particular questions shall have been answered, but which must be kept before our mind.

The first of these more comprehensive problems is that of the origin, derivation and time of coming of the yellow-brown stem of humanity. Here is a multitude of people, enough to fill three times over and more the whole American continent as it is now populated, who, though they extend from the farthest north down to the equator, present nevertheless many characteristics in common. They are not of the same color, but are all yellowish-brown, ranging from yellowish-white down to brown-black. They have all the so-called Mongolic eye, especially in the child; they are all characterized by a scarcity of beard, by black or brownish-black and wherever unmixed, straight hair, which shows also certain microscopic features that differentiate it from the hair of the rest of the human family; and there are still other characteristics that unite these people. They must all have proceeded from the same stem. But where did they originate? How, why and when did they people Asia? How did they become so subdivided and acquire their secondary differences? Notwithstanding the fact that they show so many characteristics apart from the white man, yet they show much more resemblance to him than to the blacks. There is no line of demarcation between the whites and the yellow-browns, as there is between the browns and the blacks. What is the meaning of all these facts? Here

is surely a great field for scientific determination.

But the greatest and most comprehensive of all the problems of the Far East and the southern archipelagos, is that of man's antiquity in these regions. We know that since the Tertiary these regions were and still are inhabited by anthropoid apes. We therefore have had there forms near to man since at least the Pliocene period. In the island of Java have been discovered the remains of a creature that is the closest to man of all non-human forms thus far known. Whether this being was directly ancestral to man or not does not matter; the point is that many things indicate this region as the possible site of man's earliest differentiation, of man's origin. But the truth in the case remains to be determined. Explorations in this field have thus far barely touched the surface. There are vast promising deposits, and almost endless numbers of caves that demand exploration. Of all the fields of anthropological research here is the most pregnant. And it lies fallow.

Connected with the preceding is the problem as to why early man has not populated the mainland of eastern Asia. In all this part of Asia, extending to the Turkestans, there has not been found thus far a single object which would unquestionably point to man's geologic antiquity. The objects thus far discovered over these vast regions are those of the Neolithic period, and apparently not even the oldest parts of the Neolithic. The man who occupies these territories is not allied with anything primitive; he is not very substantially different from the white man; he is more related to the white man than to the blacks; his origins point westward, not southward. The only conclusion that one can reach is that the region which is now known as China and the continent to the north of this, had never been peopled by early man, for which there must have been weighty reasons. On closer analysis it is possible to reduce these reasons to two only—either early man never was in southern Asia; or he was there in the south but was prevented from reaching farther north by insurmountable, for him, natural conditions. The fact that no trace of anthropoid apes has thus far been found in central or northeastern Asia would somewhat favor the second hypothesis. The barrier to the extension of these apes northward may have been the same that prevented a similar extension of early man or the human precursors. Though it is also possible that early man developed in the south but much farther westward, maybe even as far as the African continent. All this is to be determined. Yet certain facts indicate that, whether early man did or did not once exist in southern Asia, there did exist towards the north a barrier that might have prevented his spread in that direction. A large portion of China is covered by a peculiar Quaternary geologic formation, the so-called loess. The loess is generally poor in fossils, and geologists in China have inclined to the opinion that during the deposition of these accumulations the great region thereby covered was probably not as habitable as it is to-day; that it did not offer sufficient resources for man or many animals; that the loess formation may represent conditions such as exist in the Turkestans or southern Mongolia at this day. It appears to represent a region where the alluvia left after overflows of the rivers after they dried were disseminated by the winds and came to form the earth's surface under semi-desert conditions. But the actual facts are still to be established. This only shows how great is the need of actual investigation, geological, paleontological and from many other points of view, in these regions.

Such are at least some of the more *particular,* as well as the more *comprehensive* problems of the more eastern parts of the Asiatic continent, presented in a simple and meager manner. My object is merely to show how necessary it is for American anthropology to pay more attention to the Far East. The time has come when we must cease to be provincial. I would like to see our institutions establish proper research stations in eastern Asia where local workers could be trained for investigation in anthropology and related branches. And I would like to see the American men of science as well as others, help to establish for

China and India, the two most important centers, national Museums of Natural History which would serve as centers of anthropological, biological and geological investigation of the Far East.

ALEŠ HRDLIČKA

U. S. NATIONAL MUSEUM

SURVEYING FROM THE AIR

THE great possibilities of airplane photography in connection with the water and land work of the Coast and Geodetic Survey are looming up as a potential factor in expediting the mapping of our waterways and interior surveys. This very important subject has been the object of careful study and experiments by officers of the Survey, in collaboration with the other branches of the government, during the past year and the rapid advance in aerial photography, first seriously undertaken during the war, now promises, with proper development, a method of surveying that will probably far exceed expectations over the old methods in rapidity, economy, and minuteness of detail.

No little stress should be laid on the fact that, not only are the possibilities good for an early and complete revision of our shore topography, but the opportunities that present themselves for assisting materially in our hydrographic work shouldn't be underestimated.

With the necessary facilitates and cooperation supplied by the Army and Navy Aviation Corps to the Coast and Geodetic Survey, experience has already proven the value of aerial photography over the old method of surveying in revision surveys of our coast lines.

This work so far, is divided into two branches, *Aerial Photo-Topography,* and *Aerial Photo-Hydrography,* and the results are shown in the following recent practical demonstrations:

AERIAL PHOTO-TOPOGRAPHY

In July, 1919, experiments were made at Atlantic City, N. J., to ascertain the adaptability of airplane photographs for use in topographic mapping. The area in the vicinity at Atlantic City was chosen as it is characteristic of so much of the coastal plain territory of the Atlantic coast. This project was essentially experimental in character, but developed into one of practical value, as the photographs are being used in a revision of the charts of the New Jersey coast.

This work was done in cooperation with the Air Services of the Army and Navy. Both land and sea planes were used, and in addition several photographs were made from a dirigible. Three types of mapping cameras were tried out, the "L" type, K-1, and Trilens. An officer of the survey kept in close touch with the work and furnished the ground control, constructing special targets in some cases.

A mosaic was constructed by members of the Air Service of the Army, using the photographs made with the K-1 mapping camera. These were taken at an altitude of 7,000 feet, using a lens of 10 inch focal length, with a resulting scale of about 1:8,000. A rough control scheme was first laid out, and the mosaic constructed over this.

This mosaic and also the individual photographs have been the subject of study by engineers of the survey, especially with reference to control and interpretation. Various methods of reduction for chart use were tried out. A study was made of the accuracy of mosaics and individual photographs. The possibilities of control using the photographs themselves to establish a graphic triangulation, have been investigated. The most important point brought out from the study of the results of the work at Atlantic City, was the possibilities in revision work, especially along those sections of the Atlantic coast where the shoreline is subject to frequent changes owing to the action of the sea.

AERIAL PHOTO-HYDROGRAPHY

At the same time that the experiments at Atlantic City were being made, a distinct line of investigation was being pursued at Key West, Florida. Photographs were made by the Naval Air Service to determine the pos-

sible use of aerial photographs in connection with hydrographic surveys. The primary object in view was the elimination of wire drag work, especially in the clear water of the Florida coast. An attempt was made to photograph small coral heads and pinnacle rocks, as it is the existence of these needle-like dangers to navigation that require the use of a wire drag. The equipment at the Air Station at Key West was limited, but thorough tests were made with that available. Various types of cameras were used, as well as different combinations of filters and plate emulsions. Photographs were made at altitudes of from 200 feet up to 4,000 feet, and under various light conditions. It was hoped that some combination of the various factors involved would produce satisfactory results.

The problem of control was solved, by including in each photograph, two vessels of the survey. The photographs could not be corrected for tilt with only two known points as a base, but the control as furnished by the positions of the two vessels, was found to be sufficient for the experiments.

A well-surveyed area near Key West was chosen, and the vessels proceeded on parallel courses over this area at full speed, the plane flying forth and back above the course. The courses and positions of the vessels were recorded as in ordinary sounding work. The photographer in the plane recorded the exact time that each exposure was made, with other data such as altitude, exposure, plate, filter, etc. Each photograph was later oriented by plotting the positions of the vessels on the chart at the instant the exposure was made.

These experiments proved very conclusively that photographs from the air, using present day equipment, are of little practical value to the hydrographer. When any of the underwater features did appear in the photographs, contrast in color was the most prominent, with no indication as to whether the contrast indicated shoal or deep water. Vari-colored bottom, of uniform depth, appears in the photograph as apparent difference in depth. Many charted shoals are not indicated in the photographs, while adjacent ones show clearly. Taken altogether, the results are so uncertain, that the chances of eliminating field work in hydrography are very remote. Developments in the art of photography may change this viewpoint.

REVISION OF THE COAST OF NEW JERSEY

In March, 1920, the Army Air Service photographed the coast line of New Jersey from Cape May to Seabright. A single flight was made using the K-1 camera. The plane flew at an altitude of 10,000 feet, and under very good air conditions. The camera was mounted in gimbals, with a lead weight at the lowest point to assist in maintaining the optical axis of the camera in a vertical position. Level bubbles were placed on the camera, to aid in keeping the camera in the proper position. This is the most satisfactory way to suspend the camera, and control its verticality, at the present time. The photographs are being used for a revision of the charts of the coast of New Jersey. The individual photographs are 18 × 24 cm. in size, and the approximate scale is 1:10,000. The photographs are mounted in strip mosaics, for convenience sake, not over four feet in length. The length is generally determined by the position of control points. This composite photograph is compared with the topographic sheet of the same area, and control points identified. The scale of the photographic mosaic is determined, and by means of the pantograph, the data are reduced to the scale of the chart, and transferred from the photographs to tracing paper.

The photographing of this 120 miles of coast line took less than two hours time in an airplane. The development of the films and printing took two days time of one man. Two rolls of film were used, a total of 183 photographs. The work of interpreting the photographs, assembling mosaics, comparison with topographic sheets, and reduction to the scale of the chart of the outside shore line required 15 days of office work by one engineer.

E. LESTER JONES
U. S. COAST AND GEODETIC SURVEY

SCIENTIFIC EVENTS

THE BRITISH NATIONAL UNION OF SCIENTIFIC WORKERS

THE annual meeting of the council of the National Union of Scientific Workers was held at King's College on November 13. We learn from *Nature* that in his address Dr. J. W. Evans, the retiring president, dealt with the subject of "Research at the Universities." Dr. Evans paid a tribute to the achievements of scientific workers during the war, and pointed out that the task ahead of them was of even greater consequence and allowed of no relaxation of effort. After summarizing the activities of the Department of Scientific and Industrial Research, he expressed dissatisfaction with the present attitude of this department towards the scientific and technical faculties of the universities. He considered that a teaching staff engaged in research work, both in pure science and in its applications to industry, was in a more favorable position to discover and develop new principles than research workers isolated and restricted in the laboratories of research associations of even government research institutions. In conclusion, Dr. Evans urged the importance of universities including in any course in science some training in research methods. This he embodied in a resolution which was supported by Professor Soddy, who stated that Professor Perkin had already applied this principle to the chemistry courses at Oxford University. Chemistry students there had shown by their enthusiasm how much the change was appreciated.

Continuing, Professor Soddy said that since the president had prepared his address there had been a complication brought about by a request from the War Office that the universities should undertake research into the development to the utmost extent of chemical warfare research for offensive and defensive purposes. He expressed the view that it was a matter that must inevitably be considered, sooner or later, by the union. It ought to be considered before rather than after the occasion arose. He was glad that the executive of the union had already decided to appoint a committee to go into the whole question.

The resolution disapproving of the policy of the Department of Scientific and Industrial Research, in establishing and financing research associations, which hands over to the private use of profit-seeking monopolies valuable knowledge obtained at the expense of the whole community, and places the research associations in a position to exploit the scientific workers of the country for their own benefit, was carried unanimously. Professor Soddy stated that the government had capitulated to the big business interests in politics and departed altogether from its original intentions. There was no greater example of unfair competition than in the chemical industries.

Mr. A. A. Griffith, in moving a resolution that for the present Advisory Council of the department should be substituted a council elected on different principles pointed out that there could be little effective criticism of the department under the existing arrangement whereby the government practically appointed its own critics. It was certain that a council part of which was elected by democratically constituted scientific organizations would result in more careful scrutiny and criticism of the acts of the department.

A resolution by Mr. F. A. Potts to the effect that scientific workers employed as whole-time officials in government departments should enjoy status and pay not less than those enjoyed by the administrative class of civil servants was carried unanimously.

Professor Leonard Bairstow was elected president for the ensuing year.

PLANT PATHOLOGY AT THE BROOKLYN BOTANIC GARDEN

IN the ninth annual report of the Brooklyn Botanic Garden for 1919 attention was called to the need in this country of additional provision for fundamental research in plant diseases, and to the desirability of establishing at the garden a laboratory or institution of plant pathology. This institution is strategically located for the prosecution of certain phases of plant disease research since it is at the

center of one of the largest market garden regions in the country, is at the port of entry for most of our foreign plant importations, and at the terminus for the largest domestic shipments by rail of fruits and vegetables. The plant disease problems in connection with this commercial activity are many, and are of the highest scientific interest as well as of great economic importance. These facts have been recognized by the Botanic Garden governing committee and other friends of the garden, and a fund of fifty thousand dollars has been subscribed to become available over a period of four years from January 1, 1921. It is the intention to give special emphasis to the pure science phase of plant disease problems. A curatorship of plant pathology has been established, and it is planned to erect an experimental greenhouse at an early date. Dr. George Matthew Reed, of the Office of Cereal Investigations, Bureau of Plant Industry, Washington, D. C., has been appointed to the new curatorship beginning January 1, 1921.

THE AMERICAN PHYSICAL SOCIETY

THE annual meeting (the 106th regular meeting) of the American Physical Society will be held in Chicago, on December 28, 29 and 30, 1920, in affiliation with Section B—Physics—of the American Association for the Advancement of Science. The meetings will be held in the lecture room of the Kent Chemical Laboratory of the University of Chicago.

The program of technical and scientific papers, to be given on Tuesday and Thursday, will be in charge of the Physical Society. On Wednesday morning there will be a joint session with the Optical Society of America.

The session on the afternoon of Wednesday, will be in charge of Section B, at which time Professor Max Mason, the retiring vice-president and chairman of Section B, will give an address on "From Oersted to Einstein." This will be followed by a symposium on "Recent Progress in Magnetism" with papers by S. J. Barnett, S. R. Williams and A. H. Compton.

Other meetings for the current season are as follows:

107. February 25–26, 1921. New York.

108. April 22–23, 921. Washington.

109. Time not determined. Pacific Coast Section.

DAYTON C. MILLER,
Secretary

CASE SCHOOL OF APPLIED SCIENCE,
CLEVELAND, OHIO

THE MATHEMATICAL ASSOCIATION OF AMERICA

THE fifth annual meeting of the Mathematical Association of America and the second annual meeting of Illinois section will he held at the University of Chicago on Tuesday and Wednesday, December 28 and 29, 1920, in affiliation with the American Association for the Advancement of Science and in connection with the western meeting of the American Mathematical Society. The Illinois section will meet jointly with the Association in all its sessions, but will hold a separate business meeting on Tuesday afternoon.

On Wednesday evening at half past six there will be a joint dinner at the Quadrangle Club of all the mathematical organizations, together with Section D (Astronomy) of the American Association.

The meetings will be held in Ryerson Physical Laboratory and in the physiological laboratory. The former is situated near the corner of 58th Street and University Avenue, the latter is the southwest building of the Hull Biological group near 57th Street.

It is proposed that the Mathematical Association of America should emphasize in its meetings the presentation of historical papers, and to this end it welcomes the opportunity to meet the newly organized Section L (Historical and Philological Sciences, including the History of Science) of the American Association for the Advancement of Science in two joint sessions for the reading of such papers. It is also planned that the association should encourage the presentation of expository papers of a fairly elementary character, and several such papers have been included in this program.

SCIENTIFIC NOTES AND NEWS

Dr. Edward Rhodes Stitt, head of the Naval Medical School at Washington, D. C., has been appointed Surgeon General of the Navy, to succeed Surgeon General Braisted who retired on November 26.

Dr. Whitman Cross, of the U. S. Geological Survey, has been appointed honorary associate in petrology at the National Museum, succeeding the late Dr. J. P. Iddings.

Dr. C. L. Alsberg, chief of the Bureau of Chemistry, U. S. Department of Agriculture, was elected president of the Association of American Dairy Food and Drug Officials at the recent convention of the Association at St. Louis.

In the issue of Science for November 26 (p. 505), Dr. I. C. White should have been given as president of the Geological Society of America.

Arrangements have been made by the faculty and trustees of the University of Chicago for the painting of the official portrait of James Rowland Angell, formerly dean of the faculties and head of the department of psychology at the university, who is now head of the Carnegie Corporation of New York. Mr. Ralph Clarkson, the Chicago painter who made the highly successful portraits of Professor Thomas C. Chamberlin, former head of the department of geology, and Professor Rollin D. Salisbury, dean of the Ogden Graduate School of Science, has been engaged to paint Mr. Angell's portrait and is now in New York for that purpose. Dean Angell was connected with the University of Chicago for twenty-five years.

Dr. B. Laufer, curator of anthropology in the Field Museum of Chicago, was elected an honorary member of the Finnish Archeological Society of Helsingfors on the occasion of the fiftieth anniversary of this society on November 6, 1920, and a corresponding member of the Société des Amis de l'Art Asiatique, Hague, Holland. He has recently been appointed honorary curator of Chinese antiquities in the Art Institute of Chicago.

The recipient of the Alvarenga prize awarded by the Swedish Medical Association this year was Dr. E. Hammarsten for his work describing the isolation from the pancreas of a "coupled" nucleic acid.

Dr. C. M. Woodworth, who has been making a study of the inheritance of disease resistance in flax with the Office of Cereal Investigations, U. S. Department of Agriculture, with headquarters at Madison, Wisconsin, has resigned to take charge of the plant breeding work in the agronomy department of the University of Illinois.

Dr. Carl O. Johns, chief of the color laboratory at the Bureau of Chemistry, U. S. Department of Agriculture, resigned in November to become director of a newly-established department of general research for the Standard Oil Company of New Jersey.

Dr. Swarna Kumer Mitra, B.S., M.S. (California), Ph.D. (Ohio State), a native Hindu from Calcutta, has been appointed in the Imperial Agricultural Department of India as provisional economic botanist of Assam. Dr. Mitra sails for India early in January.

We learn from the *Journal* of the Washington Academy of Sciences that Mr. H. Pittier, of the U. S. Department of Agriculture, who is at present in Venezuela, will accompany a party of Swiss engineers who are expected in Venezuela in January for the purpose of investigating doubtful points of the Venezuela-Colombia boundary as recently arbitrated by the King of Spain. The commission will traverse the territory extending from a point on the Rio Meta to the headwaters of the Guainiia in the Rio Negro basin, a region which has probably never been visited by naturalists.

Professor Simon H. Gage spoke on November 30 before the Cornell University chapter of the Society of Sigma Xi at its first public lecture of the year. He described his recent investigations on the determination of the digestion and assimilation of fatty foods by a study of the blood with the dark-field microscope.

Baron Gerard de Geer addressed the Geological Society of Boston on November 30, on

"Spitzbergen as the key to the relation between northern Europe and North America."

THE department of physics of the Carnegie Institute of Technology recently held an evening session of its physics colloquium, at which more than a hundred guests, largely engineers and scientific men of the district, were present. The speakers of the occasion were Dr. Heber D. Curtis, the newly appointed director of the Allegheny Observatory, and Dr. Keivin Burns, astronomer. Dr. Curtis spoke on "Future work on the Einstein theory." Dr. Burn's subject was "The stars and physics."

DR. H. DESLANDRES, president of the Paris Academy of Sciences, gave, at the meeting on October 4, an *éloge* on Sir Norman Lockyer, who was a correspondent of the academy in the section of astronomy.

THE death is announced at the age of seventy-six years of Dr. Théodore Flournoy, formerly professor of physiology and psychology at the University of Geneva.

THE second annual meeting of the Mineralogical Society of America will take place in Chicago, on December 29, 1920. By a recent vote of the Geological Society of America, the Mineralogical Society of America was closely affiliated with it.

AT the Chicago meetings papers on genetical subjects will be presented at the Wednesday morning session of the Botanical Society of America, and at the Wednesday afternoon session of the American Society of Zoologists. These two sessions, together with the meetings of the American Society of Naturalists on Thursday and Friday, provide a nearly continuous program for those interested primarily in genetics and evolution. The annual dinner of the naturalists will be held Thursday evening, at the Hotel Sherman. At the close of the dinner Dr. Jacques Loeb will deliver the presidential address, "On Osmosis." A smoker for all biologists will be held Tuesday evening in the social rooms of Ida Noyes Hall, following the address of Professor W. M. Wheeler, retiring vice-president of the American Association and chairman of Section F.

A SPECIAL attraction to members of the association, and to others in attendance at Chicago will be an exceptionally interesting exhibit and working demonstration showing the apparatus and scientific principles upon which the wireless telephone is based. This collection of working models has been designed to reproduce the more fundamental discoveries in unapplied science which have paved the way for the wireless telephone and without which this great practical achievement could not have been realized. The exhibit comprises many exceedingly ingenious and spectacular automatically demonstrating models. It is especially valuable as a concrete illustration of the manner in which abstract scientific study has always had to precede practical achievements. The history of the wireless telephone as here set forth emphasizes a great principle of human progress, that the abstract scientist and reclusive philosopher of one generation prepares the way for the technician of the next; the scientific laboratory of one generation becomes the workshop of the next; the "useless theory" of one is the practise of the next. The exhibit has been prepared by the American Telephone and Telegraph Company and by the Western Electric Company, under the auspices of the National Research Council, and it has been made possible to have it at Chicago for the association meeting through the efforts of Dr. Vernon Kellogg, permanent secretary of the National Research Council, and of Dr. H. E. Howe, chairman of research extension of the council. The exhibit may be inspected at the Chicago Art Institute (Michigan Avenue near the Van Buren Street Station of the Illinois Central Railway).

THE Austin Section of the Southwestern Geological Society meets at the University of Texas, Austin, on the first Friday night of each month. The program for the present session is as follows:

October 1, 1920: F. B. Plummer, "Oil structures in the great basin of Utah."

November 5, 1920: J. W. Beede, "Geology of the Mackenzie River district."

December 3, 1920: Ira Edwards, "Geological field work in Wisconsin."

January 7, 1921: W. S. Adkins, "The Solitario."

February 4, 1921: H. P. Bybee, "The Hewitt, Oklahoma, oil field."

March 4, 1921: R. A. Liddle, "Faulting and structure in Medina County, Texas."

IN an editorial note *Nature* says: There can be no doubt that scientific progress in relation to agriculture has been seriously hampered in the past by the poor material prospects offered to the scientific worker, and the Ministry of Agriculture, in recognizing the fact and in attempting to remove the defect, has shown a spirit of enlightened goodwill which is of hopeful augury. The provision of a grant earmarked to cover the salaries of workers in universities and in institutions such as the Rothamsted Experimental Station, in addition to, and separate from, a grant for laboratory and general research expenses, is a real effort to ensure that the workers shall have some security of tenure and some prospect of a settled career in the prosecution of research. The principle is sound, but the practical application is as yet not entirely successful. A system of grading the workers is perhaps inevitable, and the salaries allotted to the different grades are in some respects not reasonable. But the annual increments are too small, espceially during the years when the average worker is marrying and his expenses are increasing, and there is not sufficient range between the extremes of the scale, *e.g.*, a worker recently graduated and beginning his career receives £450; the same man ten years later, with a wife, two or more children, and a position to maintain, receives only twice that amount, and is actually worse off than before. The total number of graded posts is much too small even to cover only those already working in agricultural research. That will, no doubt, be improved as time goes on, but meanwhile it leads to stagnant promotion and invidious selection. There must be something seriously at fault when (to take only one particular instance) a worker of more than thirteen years' experience in research, of acknowledged eminence and authority in an important subject, should be offered, and have in the meantime to accept, a post in the third grade (called "junior assistants"), and be classed along with those at the start of their career with no record of solid achievement behind them.

ACCORDING to the Dublin correspondent of the *Christian Science Monitor* the nineteenth annual report of the Department of Agriculture and Technical Instruction for Ireland has just been issued showing how its annual income of £190,000 has been spent. Agricultural purposes alone absorb £124,000 of this, £55,000 being reserved for technical instruction, and £10,000 for fisheries. During the academic year 1918–1919, 258 students attended the Royal College of Science. In addition to these there were three research students. As a result of the war there was a temporary decline in the attendance of readers at the National Library of Ireland. Many valuable additions have been made to this library. Visits to the Museum of Science and Art showed an increase from the previous year of neary 24,000 and many of these were serious students. There is a growing demand for homegrown timber, consequent on the reduction of supplies from abroad during the war, which demonstrates the inadequate provision hitherto made for the encouragement of forestry. The reconstructive committee, therefore, has turned its attention in this direction and the result of an investigation has been given effect to in the Forestry Act which came into force on September 1, 1919. The Forestry Act provides for the formation of a forestry fund amounting to £3,500,000 during the next ten years and the appointment of eight commissioners whose duty it will be to promote the interest of forestry and its developments, and the production and supply of timber. The powers and duties of the Agricultural Department are to be transferred to these commissioners. To assist them in their duties under the act provision is made for the appointment of four consultative committees, one of which will deal with Ireland.

UNIVERSITY AND EDUCATIONAL NEWS

It is stated in *Nature* that the first list of donations in response to the appeal of the University of Birmingham for £500,000 shows gifts or promises to the amount of more than £250,000. Nearly half of this amount is given to the Petroleum Mining Endowment Fund. The largest single gift is an anonymous one of £50,000 for the general fund. A sum of £5,000 is for a chair of Italian, and an equal amount is given by the James Watt Memorial Fund for a James Watt research chair in engineering.

ASSISTANT PROFESSOR EUGENE TAYLOR, of the University of Wisconsin, has been appointed professor and head of the department of mathematics at the University of Idaho.

DR. J. C. WITT, assistant professor of analytical chemistry in the University of Pittsburgh, has resigned, to become chief research chemist for the Portland Cement Association with headquarters in Chicago. Dr. C. J. Engelder, of Hornell, N. Y., has been appointed to the position at the University of Pittsburgh.

MR. WILLIAM B. BROWN, associate physicist of the aeronautic power plants section of the Bureau of Standards, has been appointed instructor in physics at the Ohio State University.

DR. RODNEY B. HARVEY has resigned as plant physiologist, bureau of plant industry, Washington, D. C., to accept the position of assistant professor in plant physiology at the University of Minnesota and assistant plant physiologist in the Minnesota experiment station.

DR. BENJAMIN SCHWARTZ, assistant zoologist in the Bureau of Animal Industry, has been appointed professor of protozoology and parasitology in the University of the Philippines and will sail for Manila late in December.

DISCUSSION AND CORRESPONDENCE

HELIUM AND HYDROGEN MODELS

TO THE EDITOR OF SCIENCE: In a communication to the SCIENCE issue of June 18 Dr. Irving Langmuir proposed a model of the helium atom consisting of a nucleus of charge $2e$ accompanied by a pair of electrons which execute symmetrical oscillations about two nearly circular arcs on opposite sides of the nucleus. In the issue of November 5 he has proposed a similar model for the hydrogen molecule, and another, of a somewhat different type, for the positively charged H_2 ion. The writer was particularly interested in these models, for in each case the resultant angular momentum is zero, a circumstance which seemed to offer an explanation of the diamagnetic behavior of helium and hydrogen, and of the failure of the theories of the specific heat of hydrogen based on the assumption that the molecule is gyroscopic.

Unfortunately, Dr. Langmuir did not see how to apply the Wilson-Sommerfeld quantum conditions to the determination of the energies of these models, and therefore was not able to fix the theoretical energies and ionization potentials definitely. These quantum conditions are

$$\begin{aligned} \int p_1 dq_1 &= \int \left(\frac{\partial T}{\partial \dot{q}_1}\right) dq_1 = n_1 h, \\ \int p_2 dq_2 &= \int \left(\frac{\partial T}{\partial \dot{q}_2}\right) dq_2 = n_2 h, \\ &\quad \cdots\cdots\cdots, \end{aligned} \tag{1}$$

where T is the kinetic energy of the atom or molecule, q_1, q_2, ... are a properly chosen set of coordinates, p_1, p_2, ..., are the corresponding momenta, and n_1, n_2, ... are any integers. Each integral is to be extended over a complete cycle of values of the corresponding coordinate. Dr. Langmuir states that he is unable to apply these equations to his models[1] because he does not know what systems of coordinates to use. The choice of a proper coordinate system is not essential, however, to the application of these conditions to the type of problem under consideration. For whatever coordinates are used, they will have a common period t, which makes possible a con-

[1] With the exception of the positive H_2 ion. He does apply the conditions to this model, and correctly, but expresses doubt concerning the validity of the somewhat unsatisfactory result on account of his uncertainty regarding the coordinate system.

venient combination of the conditions. The set of equations (1) can be written in the form

$$\int_0^\tau \frac{\partial T}{\partial \dot{q}_1}\dot{q}_1 dt = n_1 h,$$
$$\int_0^\tau \frac{\partial T}{\partial \dot{q}_2}\dot{q}_2 dt = n_2 h, \qquad (2)$$
$$\cdot\quad\cdot\quad\cdot\quad\cdot\quad\cdot\quad\cdot\quad\cdot,$$

Adding, we obtain

$$\int_0^\tau \left[\frac{\partial T}{\partial \dot{q}_1}\cdot \dot{q}_1 + \frac{\partial T}{\partial \dot{q}_2}\dot{q} + \cdots\right] dt = (n_1+n_2+n_3+\cdots)h.$$

By Euler's theorem for homogeneous functions, the integrand of the left hand member is equal to twice the kinetic energy. Consequently this integral is equal to the action of the system for the type of motion under consideration. Denoting the sum of the integers n_1, n_2, etc., by n, we have

$$A = \int_0^\tau 2T dt = nh; \quad n = (0), 1, 2, \cdots. \qquad (3)$$

This integral is invariant of the choice of coordinates and can be evaluated easily if the orbit and potential energy function are known. Equation (3) is not equivalent to the quantum conditions (1), but it is a deduction from them for the type of problem under consideration, which is sufficient to fix the possible energy values of the atom or molecule. In the normal state the atom will have the least energy possible and the quantum number n should therefore be small, though the value zero must be ruled out if there is to be any dynamic equilibrium at all. In the case of the helium atom or the hydrogen molecule, it is to be expected that n will be either one or two.

I have carried through the numerical evaluation of the action integral for the helium atom model and regret to say that the calculation shows that if the atom is given an energy corresponding to its ionization potential, the quantum condition (3) is *not* satisfied.

In making the calculation I have used an approximate expression for the path of the electron. This is permissible, since, by the principle of least action, the variation in the integral produced by a small variation in the path, holding the total energy constant, vanishes to small quantities of the first order. The determination of the approximate path was based on the data furnished by Dr. Langmuir. He says that the path of each electron is very nearly an arc of an eccentric circle subtending an angle of 155° 56′ at the nucleus. The radius vector from the nucleus to the midpoint of the orbit is 0.2534×10^{-8} cm. for an ionization potential of 25.59 volts, and the radius vector at the end of the orbits is 1.138 times as great. By expanding the expression for the radius vector into a power series in θ (the angle between the momentary radius vector and the radius vector to the midpoint), and discarding higher power terms, it is easy to show that an equation of the form

$$r = r_0(1 + k\theta^2) \qquad (4)$$

can be used to define an approximate orbit. Here r_0 is 0.253×10^{-8} cm. and k is easily calculated from the known values of r and θ at the end of the path.

The expression for the potential energy of the system is

$$\Phi = -\frac{4e^2}{r} + \frac{e^2}{2r\cos\theta}, \qquad (5)$$

where e is the charge on the electron. The total energy W is easily calculated from the above equation by inserting the values of r and θ for the end of the path. The kinetic energy of the two electrons is

$$T = W - \Phi = mv^2. \qquad (6)$$

By means of equations (5) and (6) the expression for the action is easily transformed into the form

$$A = 4\int_0^{s_m} 2mv ds$$
$$= 8e\sqrt{m}\int_0^{s_m}\sqrt{\frac{4}{r} - \frac{1}{2r\cos\theta} - \frac{W}{e^2}}\cdot ds, \qquad (7)$$

where s is the rectified length of the path from its midpoint to the point (r, θ), and s_m is the maximum value of s. The graphically determined value if the integral which forms the right hand member of (7) is 1.57 h. This result is in conflict with the quantum condition (3) and shows that if the quantum conditions (1) are correct, the Langmuir model of the

helium atom will not account for the observed ionization potentials of that element.

EDWIN C. KEMBLE
JEFFERSON PHYSICAL LABORATORY,
HARVARD UNIVERSITY

REPRINTS FROM SCIENTIFIC INSTITUTIONS

THE librarian is not alone, I imagine, in considering the bound scientific reprints issued as contributions from a given laboratory, most difficult to handle. There should really be no place for articles already published to appear except as reprinted separates. Without doubt, a bound volume of the publications of an institution serves as a report of the work done. But a list of the authors and titles of papers with the place and time of publication would serve this purpose just as well or better. Certain universities issue such lists of the publications of their staffs, and give these lists under the different departmental heads. This seems eminently worth while even where the number of publications in a department is scant.

The department of physiology of one university and the department of botany in another send to this library serial lists of their publications and with the lists the separates themselves, placed in order in a folder. This seems as nearly a perfect method as can be devised. The lists may be filed in any convenient way and the separates dealt with according to the method found most useful to the recipient. The expense of binding is saved to the institution issuing these separates, and while the distribution of the separates may be selective, the printed lists can be given a wide publicity. Such lists if issued very generally would make useful bibliographies and could be systematically filed. At the same time, the departmental library, so important in these days of disappearing private libraries, would have to handle a given article but twice, the original in journal form and the separate.

PRISCILLA B. MONTGOMERY
ASSISTANT LIBRARIAN,
MARINE BIOLOGICAL LABORATORY,
WOODS HOLE, MASS.

OBSERVATIONS ON THE PHILOSOPHY AND ETHICS OF RESEARCH AND PUBLICATION

TO THE EDITOR OF SCIENCE: Dr. Erwin F. Smith may have performed a service to the plant pathologists in publishing his "Introduction to bacterial diseases of plants," as I have no doubt he has; but he has surely performed a service to scientists everywhere, of every denomination, in publishing the last chapter of that book, "Part V. General Observations." In this he has collected the results of observation in the realms of the literature of science, the scientific method, the life of science and the science of life, all of which really does not express the material he has there collected. A catalogue of the headings the author has used will be more revealing. Here they are:

On subsidiary studies
On seeing things
On experimentation
On beginning work thoughtlessly
On interpretation of phenomena
On repetition of experiments—other people's, one's own
On publication
On clearness in presentation
On brevity of statement—when brevity is not desirable
On the ethics of research
On keeping one's own counsel
On team work
On sharing credits
On attending meetings and keeping up membership in societies, and on being generally public-spirited and helpful in science
On rest and recreation

The student of science will find here counsel of the greatest value on such a subject as the preparation of a paper. Would that I might quote all that he says! "Many a big book could have been boiled down to a few chapters, and in some cases to a few sentences, or to nothing at all, had its author been possessed of *clear ideas*." "Easy writing is hard reading." ". . . it is your solemn duty to sum up the substance of your contribution in a series of brief conclusions which every-one will read, and which, if well put, may induce many to turn back and read your whole

paper." "Either journals should publish no abstracts whatever, or else exact, useful ones." ". . . before you have gone very deep into any subject search out the literature of it and prepare a proper bibliography."

These are some aphorisms that strike one who is interested in the literary side of science. Ethics and philosophy as Dr. Smith relates them to science are equally intriguing. The value of this chapter, which appears unassumingly at the end of the book, is such that the attention of every student of science is earnestly invited to it.

FRANK PLACE, JR.

THE DIRECTORSHIP OF THE MAINE AGRICULTURAL STATION

THE Maine Agricultural Experiment Station is by act of legislature created as a department of the University of Maine. Its governing board is the trustees of the university. The director reports to the president of the university. The heads of the station departments report to the director. At the reorganization of the station in 1888 the trustees created a representative body to be called the station council for "the development and management of the station."

By act of legislature the experiment station was directed to conduct investigations into animal husbandry. The prime object was to try to learn how milk production and milk fat production are inherited. As one part of this work a herd made up of reciprocal crosses of high and low producing cows was essential. Such a herd was developed at the university in cooperation with the College of Agriculture. In November, 1919, without consultation with the station staff or the station council the trustees ordered this investigation stopped and the animals making up the herd sold. In January, 1920, after station council action, a committee from that body waited upon the trustees and presented a plan for continuing this investigation at Highmoor Farm. This plan was unanimously approved by the trustees. Among the items approved and as taken from the trustees records of that meeting is "The plan includes the use of certain barn space at the farm and the construction of an additional barn for housing, and water supply and equipment for caring for the animals and their products." Acting under this authority the council committee and the station director immediately took steps to put this action into effect. A barn was erected, the old barn remodeled, a well drilled and equipment purchased. The building of the barn was inspected in June when it was about half completed by a committee of the trustees who were appointed by the board with full authority relative to the new construction at Highmoor Farm. The committee from the station council met with the committee from the trustees. Neither at that time nor at any time while the construction was in progress did the trustees make any suggestion as to change or modification of the trustee action of January, 1920.

November 29 without previous notice the director of the station was requested by telephone to go to Bangor to meet the board of trustees. When he appeared he was told by the president of the board that the trustees unanimously demanded his immediate resignation. On asking why, the director was informed that by building a barn at Highmoor Farm he had exceeded his authority. The director denied that he had exceeded authority and cited the paragraph from the trustee records above quoted. He refused to resign. At about 10 o'clock the morning of November 30 he received a notice signed by the clerk of the board of trustees notifying him that the trustees had removed him from being director, the removal to be effective December 1. The director spent the remainder of the 30th putting station matters in the best shape possible for leaving in the limited time. As the trustees had delegated no one to take his place and as they had ignored the president of the university in the matter by sending the communication of removal direct to the director, the director suggested to the heads of the station that they should continue to act automatically in station management as they would were the director temporarily absent. And there the matter now rests.

The Maine Station in its 35 years of existence has through its discoveries added many millions to the wealth of the state. It is the only research agency the state has for discovering the laws underlying successful agriculture. Research is slow painstaking work. The research worker must be kept from harrowing concern. For it is only by concentration on his project that success can be had. This action of the trustees has fundamentally disturbed the confidence of the research man. He argues if the director after a quarter of century of faithful work is dismissed without adequate reason, where does he stand, what hope has he of being able to complete a study that must extend over long periods of time? At no time in the history of the station does it so need the steadying hands of friends of agriculture. The last request of the removed director is to the friends of agriculture, and he is happy and proud to know they are for the most part his personal friends as well, to come to the support of the station. It has been receiving $5,000 a year from the state for its support. To tide it over until increased federal appropriations which are being asked for in a nation-wide movement are available, this amount must be increased to $25,000 a year. Otherwise it will not be possible for any one to hold the present very efficient organization together. Help will come from the outside eventually but for this help to be efficient the agriculture of the state must see to it that the legislature makes provision for its immediate support.

CHAS. D. WOODS

QUOTATIONS

SCIENCE AND THE NATION

MOST of us receive daily appeals for war memorials of various kinds. Would not the best, and, in the end, the cheapest, war memorial be a growing and efficient body of brain-workers, able and willing to solve the problems which the war has left in its train, and to help the nation in its hour of need? For leaders both in peace and war we must find and train men who will be competent to use the national resources in the most effective manner. Scientific workers are naturally marked out by their progressive instincts and severe training to serve not merely in an advisory capacity in the councils of the nation, but also as executive officers. Moseley and others of his type will not have died in vain if the Cenotaph reminds us that men of science must take an active part in the affairs of state, in guiding the development and thought of the nation, and in seeing that the bitter lessons learnt during the last six years are not forgotten.

This end will not be attained by service on committees, whether for chemical warfare or any other subject. If the War Office seeks to be scientific it should establish within itself, as the Admiralty has done, a research department with distinguished men of science as permanent members of the staff to suggest and supervise work on methods of modern warfare. It would be the business of such officers to make use of science for purposes of national security, and workers in university or other laboratories could please themselves whether they cooperated or not in particular researches or experiments. We can understand the objections offered by Professor Soddy and others against men of science associating themselves as a body with problems of this type, but until human nature reaches a higher ethical plane than it occupies at present we must have a War Office, and an essential part of it should be an able scientific staff, the members of which would be responsible for making us strong enough to meet any crises which the future might bring. No committee of sixty or more associate members can do this, and none would be necessary if the War Office ranked a scientific service with the General Staff, as it should do, instead of inviting scientific workers to devote their time and knowledge to "offensive and defensive aspects of chemical warfare" for little more than out-of-pocket expenses.

We claim for science a much more responsible position, and a far higher appreciation of its worth, than our war leaders offer to it even now; and we do so because we remember that

thousands of young lives were lost through its neglect. When we bow our heads before the Cenotaph we think of the highly trained men of science who were killed at Gallipoli or drowned in the mud of Flanders while Ministers turned for advice to alchemists and circle-squarers, or confused great chemists with dispensers of drugs, and we wonder whether even now anyone in power realizes what civilization has lost through the sacrifice of creators of knowledge. While we mourn their loss, let us work and pray for the scientific enlightenment of the leaders into whose hands the destinies of the nation are entrusted, so that we may be assured of strong and effective guidance whatever is before us.—*Nature*.

SCIENTIFIC BOOKS

The Geology of South Australia. By Walter Howchin, Lecturer in Geology and Paleontology in the University of Adelaide. Published by the Education Department, Adelaide, 1918. Pp. xvi + 543.

Division I. of this book is a general review of geologic processes and principles, with illustrations drawn chiefly from the geology of Australia. Incidentally, the illustrations bring out many facts concerning Australian geology, some of which are not readily available to the general reader. For example, in the discussion of deformation, it is stated that there are two belts of "settlement" (subsidence), one meridional, giving rise to the great rift valley, the ends of which make the present great gulfs, the other along the continental shelf at the south, running northwest and southeast, its location being about where the shallow sea floor slopes down to the depths. Settlement still is in progress in both these zones, and the earthquakes of Australia, of which two have been recorded in recent times, one in 1897, and one in 1902, are connected with the sinking.

Division II. of the volume deals with the historical geology of South Australia, but, fortunately, comprehensive notes are appended concerning the geology of other parts of the continent, so that this part of the book is a summary of Australian geology, with chief emphasis on South Australia. Brief correlation notes tie up the geology of the continent with that of England. The sections dealing with the Cambrian and the Permo-Carboniferous are perhaps of greatest interest because these systems have large and instructive representation in the continent. The Cretaceous also is represented in a large way.

The volume has excellent illustrations, both photographic and diagrammatic. The illustrations of Cambrian fossiliferous limestone, p. 377, are examples of the former, and the section of Mt. Remarkable, p. 279, of the latter.

The hope may be expressed that when a second edition of the book shall appear, a little more stress may be laid on the physical events in the history of the continent, as for example, the character, extent and dates of the principal deformations. If knowledge permits their preparation, paleographic maps would be most welcome. The volume is a very useful one, and adds much to our knowledge of the geology of the continent.

Rollin D. Sallisbury

University of Chicago

SPECIAL ARTICLES

THE COMPRESSION OF A SOUND WAVE

Lord Rayleigh and more recently Professor A. G. Webster and others have given considerable attention to this problem. The following experiment, which is, I think, capable of exact development, is a further contribution.

1. *Apparatus*.—Many years ago[1] I showed that displacement interferometry lent itself favorably to the study of a diabatic expansion and this is particularly the case when the achromatic fringes are used. It is therefore suggested that the endeavor to look with the interferometer through the nodes of an organ pipe would not be unsuccessful.

Open pipes *P*, adapted for the purpose in question, are shown in Figs 2, 3. In Fig. 2, cylindrical adjutages *pp'*, of somewhat smaller diameter than the pipe (open within, but closed by glass plates *gg* on the outside) are

[1] Carnegie Pub. 149, Ch. XI., 1912.

introduced at the node N, symmetrically and at right angles to the pipe. The effect of this is to lower the pitch to a degree increasing with the length of p. If p is not too long, one may argue that the resilience of air at the node is decreased, and the period lengthened much in the same way in which an increased capacity operates in an electric circuit. The fundamental pitch was depressed about a fourth. The first overtone however occurred at about a tenth above this and came out very shrilly, probably because it coincided with the octave of the unchanged pipe. Moreover this first overtone is probably the fundamental of the small pipes p, p'. Thus this overtone here also presents two nodes of the same kind, both compressed and both rarified, and the optic effects (ray L) are correspondingly intense.

The other form of pipe (shown in Fig. 3) has the plane of the embouchure at right angles to the axis of the pipe, which is closed at g by a knife-edged glass plate. The other end may be open, or closed with glass. The path of the interferometer beam is shown at L. Since the distribution of density is simple harmonic, the details are here quite open to computation.

Another available pipe is simply an open tube to be excited by resonance. This case is in a measure the most interesting of the three.

Finally the plan of quadratic interferometry is indicated in Fig. 1, L being a beam of white light from a collimator, with fine slit,[2] M, M', N, N', the mirrors, N and M' half silvered and identically thick. Small fringes (1/10 mm. in the ocular) suffice. The pipe is in position at g p Pp' g' and G is a glass compensator. In order that the fringes may be of any desirable size and at any inclination (horizontal preferable), two plate compensators C, C', revolvable on vertical and horizontal axes, may be installed. If however the mirrors M', N' turn conveniently on horizontal aves, and M, N on vertical axes, the former may be used to give the fringes a horizontal trend and the latter, thereafter, for enlarging them.

When the pipe sounds sharply, the acromatic fringes necessarily vanish. Hence they

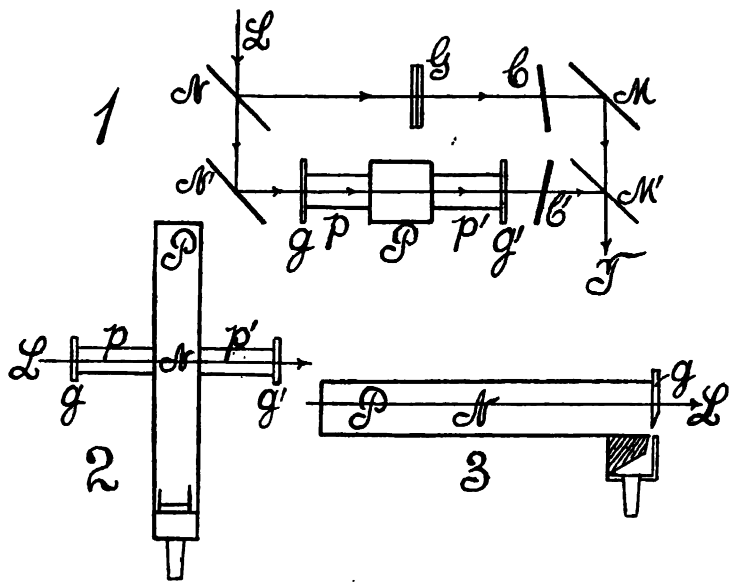


FIG. 1.

[2] The fringes at rest look like beads on a black string. There are about three colored fringes on either side of the middle one which is white.

must be observed at T by a *vibration telescope*,[3] in which case magnificent wave forms appear, measurable in amplitude.

2. *Observations.*—In the experiments, when the pipe P, Fig. 2, sounded its fundamental as softly as possible, the even horizontal band of fringes became definitely sinuous. Probably at the limit of audition there would be no response, except with much larger fringes. A strong fundamental makes the double amplitude about a fringe or more in width. The waves of the overtone are correspondingly shorter and high. The adjutages measured $l = 21$ cm. between plates. Reducing this to $l = 14$ cm. the fundamental came out much stronger, but the loud overtone gave a more confused record. Without adjutages the fundamental ($l = 5$ cm.) still evoked very marked waves, but the response of the shrill octave had naturally quite vanished. Moreover the form of the waves, obtained here without any mechanism but with the even harmonics deleted, is of additional interest.

3. *Deductions.* — Apart from details, I showed in the early paper[4] that for a length of tube l containing homogeneous air, the density increment $\Delta\rho$ for the wave-length λ may be written $\Delta\rho = (C/lR)n\lambda$, where $C = 10^7 \times 1.27$ is the optic constant $p_0(\mu_0 - 1)_0$ and n is the total fringe displacement. Hence if

$$l = 20 \text{ cm.}, \ \lambda = 6 \times 10^{-5} \text{ cm.}, \ \rho = .0013,$$
$$n = 1/10, \ \Delta\rho/\rho = 1.03 \times 10^{-8}$$

for the soft pipe note. Rayleigh considers $dp/p = 6 \times 10^{-9}$ just audible, so that my value is of a reasonable order, holding about 2.4×10^5 times more energy per average cm.[3] ($p\ d\rho/\rho = 10^3$ ergs/cm.[3]) than Rayleigh's limiting note. For the shorter adjutages the main energy would be correspondingly larger. An open cylindrical resonator close to an equipitched open organ pipe can just be seen to respond. Blown at its edges by a lamella of air, however, strong waves antedate the first audible sibillation of pitch. Into the variety of interesting stroboscopic effects I can not enter here.

CARL BARUS

BROWN UNIVERSITY,
PROVIDENCE, R. I.

[3] Carnegie Publ. No. 249, III., Chap. V.; IV., Chap. VI., 1919.

[4] C. P., 149, p. 145.

THE AMERICAN CHEMICAL SOCIETY

(Continued)

A mosaic disease of cabbage as revealed by its nitrogen constituents: S. L. JODIDI, S. C. MOULTON and K. S. MARKLEY. The cabbage disease investigated is characterized by denitrification taking place in the affected tissues, whereby the nitrates are in part reduced to ammonia which is lost as such, and in part to nitrites which reacting on the amino groups of the various organic compounds —acid amides, amino acids, etc.—bring about the elimination of elementary nitrogen. This is the reason why diseased cabbage tissues have a smaller proportion of total, nitrate, acid amide, diamino and monoamino nitrogen, nitrites occurring in diseased tissues only. Denitrification occurs in affected cabbage leaves in a very much higher degree than it does in the roots. There is a higher proportion of protein in the diseased cabbage tissues than in the normal. Loss of nitrogen in the affected cabbage tissues is in itself an explanation of the cabbage disease. Thus, *e.g.*, one of its conspicuous characteristics, the dwarfing of the plants, is easily understood when we bear in mind that the nitrogenous compounds such as acid amides, amino acids and others, which are partly lost through denitrification, are the very materials out of which the plant is building up its tissues. In the healthy cabbage samples the nitrogen is made up, in round figures, of 30 per cent. protein nitrogen, 7 per cent. diamino nitrogen, 10 per cent. mono-amino nitrogen, and 13 per cent. peptide nitrogen, which means that at least 13 per cent. of the nitrogen compounds present in cabbage have direct nutritive value.

The influence of the diet of the cow upon the fat soluble and water soluble vitamine of cow's milk: R. ADAMS DUTCHER, CORNELIA KENNEDY and C. H. ECKLES. Albino rats were fed purified diets containing casein, dextrin, agar, butter fat, wheat embryo extract and an adequate salt mixture. Varying quantities of winter milk and spring milk were fed with diets containing no added butter fat and with other diets containing no embryo extract. It was found that spring milk is superior growth-promoting properties with regard to both the fat soluble and the water soluble vitamine.

When the milk is at its best 10 c.c. will furnish sufficient water soluble and fat soluble vitamine for normal growth in the albino rat. When winter butter fat was fed it required 20 per cent. of this fat in the ration to furnish sufficient fat soluble vitamine for growth. Several rats lost weight and died while being fed a diet containing 20 per cent. of winter butter fat.

The influence of the diet of the cow upon the antiscorbutic and nutritive properties of cow's milk: R. ADAMS DUTCHER, C. H. ECKLES, C. D. DAHLE, S. W. MEAD and O. G. SCHAEFER. Two cows were fed a vitamine-poor type of winter ration for a period of five months during which time the milk was fed in varying quantities to guinea-pigs which received a basal diet of oats. New sets of pigs were added as the experiment progressed. After five months the diet of the cows was changed abruptly to a high vitamine diet and the cows were given access to green grass. During this period several sets of guinea-pigs were fed as in Period I. As we announced previously, it was found that spring milk is superior to winter milk in antiscorbutic and nutritive properties. It was also found that there is a decided tendency for the nutritive properties of the milk to remain relatively good for four to eight weeks after the cow has been placed on a vitamine-poor winter ration. On the other hand, the nutritive superiority of spring milk became evident almost immediately after the cows were placed upon green grass.

The influence of the diet upon the growth and development of testes and adrenals in White Leghorn cockerels: R. ADAMS DUTCHER and S. D. WILKINS.

Further observations on the antineuritic properties of chemical substances: R. ADAMS DUTCHER, G. E. HOLM and HARLOW BIERMAN. We have noted, in a previous publication, the fact that thyroxin (the thyroid hormone) possesses antineuritic properties. Due to the fact that this compound contains an indol nucleus, we have extended our studies to other indol derivatives. Thus far we have been able to demonstrate that α-keto-β-propyl-indol possesses decided antineuritic properties. Similar observations were made in the case of N methyl-β-ethyl-indolinon. Negative results were obtained with N methyl-β-methyl-indolinon and α-phenyl-β-methyl-indol.

A study of certain physico-chemical and colloidal properties of the glutens from strong and weak flours: PAUL FRANCIS SHARP and ROSS AIKEN GORTNER. Gluten from flours of widely differing quality were studied with respect to (1) rate and extent of imbibition in the presence of acids, (2) rate of imbibition in the presence of alkalis, (3) the effect of salts on imbibition in alkalis, (4) the gold number of the gluten, (5) the binding capacity of the gluten as measured by titration and by the potentiometer, (6) the specific conductance of gluten sols dispersed in dilute alkali, (7) the viscosity of the gluten and gluten sols, (8) the isoelectric points of the various glutens, and (9) the effect of drying in vacuo on the physico-chemical properties of the gluten The results indicate that there are marked differences in the physico-chemical colloidal properties of the different glutens in addition to those which have already been observed in rate of imbibition and imbibition capacity. Apparently the colloidal condition of the gluten is at least one of the major factors which must be considered in the problem of flour strength.

Further observations on the relation between the imbibition of the gluten and the strength of wheat flour: C. H. BAILEY and S. D. WILKINS. A study of flours of varying degrees of strength indicate that low strength is not necessarily attributable solely to inferior quality of gluten as indicated by lower hydration capacity of the latter in the presence of dilute acids. Low percentages of gluten contribute to a general reduction of baking strength, other things being equal. Occasionally, however, a low gluten flour will possess a baking strength above the average of its type, in which an abnormally high quality of gluten is generally indicated by its high hydration capacity. It is further probable that the complex known as strength is influenced by the quantity and character of yeast nutrients and fermentable material in the dough. The strength of flours which are normal in other particulars seems to be depressed by deficiencies in yeast nutrients.

Some observations upon the isolation of cystine from keratins: GEORGE E. HOLM and WALTER F. HOFFMAN. Cystine could not be prepared from human hair washed in hot dilute sodium carbonate solution, while from hair washed in cold dilute sodium carbonate solution cystine was easily obtained. Hair heated with 1 per cent., 2 per cent. and 4 per cent. Na_2CO_3 for 1, 2, 4, 8 and 16 hours removed from 6 per cent. to 55.67 per cent. of the S, while very little hydrolysis, measured by amino nitrogen occurred. Pure cystine treated in the same manner (2–8 hours) lost 1.7–14 per cent. of

its sulphur, 20 per cent. of its amino nitrogen and changed considerably in its specific rotatory power.

Biochemistry of plant diseases. III Effect of the brown rot fungus on plums: J. J. Willaman and M. Sandstrom. Five varieties of plums were subjected by rotting by *Sclerotinia cinerea.* The changes in composition of the tissue were characterized by (1) an increase in the P_H values, (2) a decrease in the titre, (3) a decrease in the malic acid, (4) formation of oxalic acid, (5) marked decrease in tannin. The ratio of protein to non-protein nitrogen increases during rotting and during the ripening of the plums.

The apparently specific effect of ammonia in the oxidation of butyric acid with hydrogen peroxide: Edgar J. Witzemann. Ammonium butyrate in dilute aqueous solution in the presence or absence of excess ammonium hydroxide is readily oxidized by hydrogen peroxide. Sodium or potassium butyrate in the presence of absence of excess of the alkali hydroxide is scarcely oxidized at all by hydrogen peroxide. These facts are of especial interest because they offer a new and rational interpretation of the interrelation of increased urinary ammonia and increased fat and protein oxidation in acidosis. The fact that large amounts of acetone are obtained in this oxidation of ammonium butyrate, as was shown also by Dakin in 1908, supports the application of the results to the interpretation of acidosis metabolism.

Antibody studies—Part 3. A preliminary report on the chemical nature of bacterial antibodies? F. M. Huntoon, Peter Masucci and E. Hannum. Presented by Peter Masucci. Bacterial suspensions were sensitized with specific serum. The protective antibodies were removed from the sensitized antigen by various solvents. The resultant solution was filtered through a candle and its protective antibody content determined by the U. S. Hygienic Laboratory method for testing the potency of anti-pneumococcus serum. Direct and indirect chemical methods as well as biological methods used show that protective antibodies are colloidal in nature, are not soluble in ether, and do not belong to the globulin group of serum proteins. They are not destroyed by the action of trypsin over long periods of time, and are not affected by certain dilute acids and alkalies or 30 per cent. sodium chloride solution. Heat above 60° C. progressively destroys or alters their nature. We may state that antibodies do not belong to that group of proteins usually considered under the head of serum proteins.

The non-catalase decomposition of hydrogen peroxide by aromatic hydrocarbons and their derivatives: Sergius Morgulis and Victor E. Levine. The experiments arose from the accidental observation that an enzyme preparation preserved with toluene had acquired a remarkably increased capacity for decomposing hydrogen peroxide. Euler and Blix have recently published the fact that yeast catalase is activated by toluene. The idea of an activation of the enzyme by toluol seems entirely improbable, for we have found that toluene alone even in minute quantities decomposes hydrogen peroxide. The action of toluene is also characteristic of other hydrocarbons of the benzene group. These compounds form a series, according to the number of methyl radicles attached to the ring, with a gradually decreasing power to decompose hydrogen peroxide, thus Benzene > Toluene > Xyluene > Mesitylene. The reaction is not general for aromatic hydrocarbons but is specific for those of the benzene series. Hydrocarbons with more than one benzene ring, like diphenyl, diphenylmethane, benzidine, naphthalene, anthracene and heterocyclic compounds do not react. The introduction into the ring of a COOH group, $NHNH_2$ group or one or more phenol groups renders the hydrocarbon incapable of decomposing hydrogen peroxide. The substitution of a nitro, amino or aldehyde group, or of a halogen atom for hydrogen does not prevent the breaking up of hydrogen peroxide, although the catalytic power of such substituted compound is much less than that of the corresponding hydrocarbon. The decomposition of hydrogen peroxide by aromatic hydrocarbons and their derivatives is not caused by changes in surface tension.

Charles L. Parsons,
Secretary

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, DECEMBER 24, 1920

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

MEDICAL ZOOLOGY IN EUROPE[1]

MY appointment as a representative of the school of hygiene and public health of the Johns Hopkins University to the Congress of the Royal Institute of Public Health which met in Brussels on May 20 to May 24, 1920, made it possible for me to spend over four months at institutions where medical zoology is taught and investigated in Belgium, France, England, Switzerland, Italy and Monaco. Among the institutions visited were faculties of science and medicine connected with universities and medical schools, research institutions both private and governmental, biological stations at the seashore, natural history and medical museums, veterinary schools, sanitary institutes, schools of tropical medicine, army and navy medical colleges, experiment stations, and academies of science. In all 67 such institutions were visited and over 150 men who are more or less interested in protozoology, helminthology or medical entomology were interviewed. An opportunity was thus afforded to become fairly well acquainted with the status of medical zoology in Europe.

Paris is, of course, the most active educational center in France. Here are located the faculties of science and medicine of the University of Paris, the Pasteur Institute, the National Museum of Natural History and the National Veterinary School. In the medical school courses are given in parasitology, tropical medicine, and colonial medicine and work is carried on for the Doctor of Science degree. The recent death of Blanchard has taken from France the grand old man in parasitology. His laboratory is now in charge

[1] From the department of medical zoology of the school of hygiene and public health of the Johns Hopkins University, Baltimore, Maryland, U. S. A. Read before the Society of Hygiene of the Johns Hopkins University, November 3, 1920.

of Professor E. Brumpt who has working with him Dr. M. Langeron and Dr. C. Joyeux. The laboratories are pleasant and comfortable and are excellently supplied with collections of specimens, charts, and reprints. Professor Brumpt is revising his book on parasitology and is studying piroplasmosis in dogs and cattle; Dr. Joyeux is devoting his time to the problem of the transmission of tapeworms in cattle and poultry and is carrying on experiments with mealworms and Dr. Langeron is at work on the morphology of mosquitoes. Also connected with this laboratory are Dr. Robert Dollfus who is preparing a monograph on larval trematodes and Dr. E. Tejera, of Caracas, who is investigating Chagas' disease. Here I heard the first of the complaints that I was destined to listen to throughout my entire trip. As in other countries the cost of living has increased out of all proportion to the salaries paid to men in educational work; the cost of printing has risen to such a degree that investigators are unable to publish the results of their work; and the unfavorable rate of exchange makes it practically impossible for either men or institutions to purchase scientific books and periodicals. I was asked by many of the men I visited to do all I could to help them obtain American publications, and enquiries were made as to the possibility of publishing in American journals. These countries have also suffered more than we have from the loss of young men, a condition it will take several generations to remedy.

Professor G. Caullery and his associate, Dr. C. Perez, of the faculty of sciences, occupy a building that was formerly a residence several squares from the Sorbonne. Here they have conducted important researches in protozoology and entomology.

The Pasteur Institute in Paris need not be described to this audience. It is not as badly off as some of the other institutions visited; its income is, I believe, about the same as before the war but due to the increase in prices, has a purchasing power only one third as great as formerly. Professor A. Laveran, who discovered the malaria organism in 1880 and has done such fine work with trypanosomes and other protozoa is now very old. Nevertheless, he goes to his laboratory every day including Sunday, and took an active interest in my account of the experimental work being done with trypanosomes in this school. His colleague, Professor F. Mesnil, is very energetic and an enthusiastic investigator of blood-inhabiting protozoa. Other investigators now working with Laveran and Mesnil are Dr. G. Franchini, of the University of Bologna, who is studying the relation between the intestinal flagellates of insects and the blood-inhabiting flagellates of man, and Dr. Perard, of the School of Veterinary Science of Paris, who is studying the human trypanosome, *T. venezuelense*, recently discovered in Venezuela.

An awakening to the value of public health work in France and other European countries is evident from the plans reported to me by various men in Paris. Dr. Brumpt told me of a school of hygiene and public health which is to be established in Paris as soon as funds are available; Dr. Franchini stated that the Italians hoped to build up a school of hygiene in Naples; and later I was told by Dr. O. Van der Stricht, of Ghent, that a similar institution is planned by the Belgians for Antwerp.

The National Museum of Natural History in Paris is an institution every zoologist visits with reverence since it is associated in our minds with the names of such men as Lamarck, Cuvier and Buffon. The collections include type specimens of many of our best known animals that were prepared for exhibition purposes, named and described by these early naturalists. To a medical zoologist the most interesting exhibit here is that of the Arachnida made by Dr. E. Simon. This, I believe, is the best collection in the world, and includes representatives of all species that are known to transmit piroplasmas, spirochetes, rickettsias and other pathogenic protozoa. The methods of preserving and mounting these and other specimens are very instructive.

At Alfort near Paris is the National Veterinary School. The French helminthologist,

Railliet, did most of his work here. Only recently he has retired and his former colleague, Professor A. Henry has taken his place. The investigations carried on here are naturally with the parasites of domestic animals; but comparative helminthology is a subject of great importance since it is continually illuminating many of the puzzling problems in human parasitology.

Opportunity was afforded me while in Paris to attend meetings of two scientific societies, the Biological Society and the Academy of Sciences, where many current investigations in medical zoology are reported.

Outside of Paris are many French institutions that count among their instructors men who are interested in some phase of medical zoology. Most of the universities, however, have only partially recovered from the war. At Amiens the Bureau of Hygiene occupies only two small rooms in the City Hall and is devoted principally to water analysis. The hospital is in poor condition and certain of the professors in the medical school must supplement their salaries by the income derived from drug stores. The school of medicine at Lille was stripped by the Germans of nearly everything and must be built up again almost from the beginning. The department of medical zoology under the direction of Professor P. Verdun and Dr. P. Desoil is gradually recovering and a small but good collection is being formed.

The University of Rennes was not in the war zone and is suffering only from loss of men and lack of funds. Professor L. Bordas was at work here on entomology. The universities at Toulouse and Bordeaux were closed when I visited them.

The French coast is dotted with biological stations where men from France and other countries have been accustomed to gather during the summer. The Russian Zoological Station is situated at Villefranche-sur-Mer near Nice. Here before the war there were usually about thirty investigators during the summer. Now the station is occupied by only one man, Dr. G. Tregouboff, a protozoologist.

The oceanographic museum of Monaco built and maintained by the Prince of Monaco, who has for many years been interested in oceanographic research, appears to be very little affected by the war. Here I found Drs. L. Sirvent, G. Dahl and M. Oxner at work on the various phases of oceanography, parasitic organisms being only incidentally studied.

The zoological station at Cette which normally accommodates about thirty investigators is being used by only one man, a protozoologist, Dr. J. L. Lichtenstein. The biological station at Arcachon near Bordeaux, formerly was used in the summer by sixteen or more investigators and published the results of their researches. At present it is deserted except for the director, Professor A. Jolyet.

Much better conditions were encountered at Roscoff on the northern coast of France. I found about fifty men at work here under the leadership of Professor Y. Delage. These investigators came from many cities and countries. Paris, Montpellier, Strassbourg, Bucarest, Bordeaux, Rennes, Utrecht, etc., were represented. Nevertheless the station is not so flourishing as before the war.

The Congress of the Royal Institute of Public Health which was held at Brussels on May 20 to May 24 was successful in every way. Large numbers of members and visitors attended, coming especially from France, Belgium, England and the United States. King Albert honored the congress by his presence at the inaugural meeting and Queen Elizabeth entertained the ladies of the congress at her home at Laaken. Sections were held at which papers were read and discussed on state medicine, naval, military, tropical and colonial medicine, municipal hygiene, industrial hygiene, bacteriology, chemistry, and hygiene and women's work. The Harben Lectures were delivered in English by Professor Maurice Nicolle, who spoke on antigens and anti-bodies, and the Harben Gold Medal was presented to General Gorgas at the final banquet given in the Taverne Royale on May 24. Excursions were arranged to the Belgium Front and to institutions of public health interest in the neighborhood of Brussels.

The School of Tropical Medicine in Brus-

sels exists for the purpose of training both men and women for work in the Belgian colonies. Among these are sanitary inspectors, missionaries, both Roman Catholic and Protestant, negroes for practical work in the villages and female nurses as assistants for the physicians at the larger stations. The rooms of the chateau in which the school is located have been successfully modified into laboratories and class rooms. Dr. Broden has charge and is assisted by men who are connected with neighboring institutions. Dr. Broden teaches protozoology; tropical pathology is taught by Professor C. Firket, of Liège; bacteriology and helminthology by Professor L. Jacque, of the University of Brussels, and medical entomology by Professor G. Severin, of the Museum of Natural History. Three courses of fifteen weeks each are given each year because of the great demand for trained helpers in the tropics.

No one who visits Brussels should fail to call on Dr. J. Bordet at the University of Brussels and on Drs. Severin and Ball who are engaged in entomological research at the Royal Museum of Natural History. Dr. L. Gedoelst, a prominent parasitologist, is located at the School of Veterinary Medicine here. Trips to Liège, Louvain, Bruges and Ghent may be arranged very easily from Brussels.

The parasitologists of Switzerland are scattered among the universities. At Basel is located Professor F. Zschokke who has published investigations on both protozoa and parasitic worms. Associated with him is Dr. Menzul who is a student of the nematodes. At Neuchatel, Professor O. Fuhrmann has charge of the department of zoology, and carries on researches in animal parasitology. The University of Lausanne possesses an Institute of Hygiene and Parasitology of which Professor A. Galli-Valerio has charge. This institute has beautiful laboratories and equipment and an excellent collection but at present its funds are so low that the director is without competent assistants; the result is that a large part of his time is devoted to taking care of the laboratory. At Geneva there is a similar institute with Professor E. André in charge. One of the few scientists who are not officially connected with some educational or governmental institution is Dr. E. Penard, of Geneva, who has been for many years one of the foremost students of the protozoa. Dr. Penard now has completed the manuscript of two monographs on ciliates and flagellates respectively but has no funds for their publication.

Successful visits were made to two of the universities in Italy. In Turin I found Professor E. Perroncito at the Medical Veterinary School. Dr. Perroncito was one of the first to interest himself in animal parasites. He is at present attempting to increase the food supply in Italy by popularizing bee-keeping. Professor C. Parona, another of the older parasitologists was absent, from his laboratory in Genoa. Professor B. Grassi, of Rome, is hard at work on a campaign for the eradication of malaria in the neighboring city of Fiumicino. Dr. Grassi has never lost interest in this subject since he first proved that certain mosquitoes transmit the malaria organism from man to man. Other students of animal parasites in Rome are Professor A. Splendore, who has just published an account of the parasites of the field mouse, and Professor G. Alessandrini, who is located at the zootechnical institute. As in France, Belgium and Switzerland the salaries of scientists in Italy have not kept pace with the cost of living and the funds available for carrying on and publishing investigations are woefully inadequate.

London is perhaps the greatest center of medical education and research in the world. Here are located a flourishing school of tropical medicine, army and navy medical schools, various other government institutions that support medical research, private research foundations, medical schools connected with a number of hospitals, medical museums and many medical societies. Besides this there are colleges and natural history museums where men are studying medical zoological subjects.

The London School of Tropical Medicine has recently moved into a building that was formerly used as a hotel but has been adapted for hospital and teaching purposes. The first

three floors are devoted to laboratories and class rooms and the upper four floors are used as a seaman's hospital. Here patients with tropical diseases are brought from the hospitals at the docks and both students and instructors have access to an abundance of material. The subjects in which laboratory instruction are given are protozoology, taught by Professor J. G. Thomson; helminthology, by Professor R. T. Leiper, and medical entomology, by Professor A. Alcock. Besides this there are numerous lecturers. Among those that I heard during my six week's residence at the school were Dr. Castellani, on mycology; Dr. James, on malaria; Sir Leonard Rogers, on leprosy; Sir Joseph Cantlie, on liver abscess; Dr. G. C. Low, on amebic dysentery, and Dr. P. Manson-Bahr, on bilharziasis and kala-azar. The clinical side of tropical medicine is in charge of Drs. Low and Manson-Bahr and Sir Joseph Cantlie; and the pathological side is in the hands of Professor H. B. Newham. The course occupies twelve weeks and each of the three laboratory subjects, protozoology, helminthology and medical entomology, is given a total of 72 hours. The clinical and pathological aspects of medical zoology are entirely under the control of the medical staff. The latter are particularly interested in methods of treatment and are frequent contributors to the literature on this subject. The regular instructors devote their spare time to the parasites themselves. Dr. Thomson is continuing his serological work on malaria, and Dr. Leiper is carrying on investigations on the elimination of hookworm from mines. In the same building, with the School of Tropical Medicine, is the Tropical Diseases Bureau, under the direction of Dr. A. G. Bagshawe. This bureau publishes the *Tropical Diseases Bulletin* and the *Tropical Veterinary Bulletin*.

Across the street from the School of Tropical Medicine are the new laboratories of the Wellcome Bureau of Scientific Research. No teaching is done here and so the men may devote their time to research. Dr. A. Balfour, who is director of the bureau, and Dr. C. M. Wenyon, are both protozoologists. Entomology is in charge of Dr. Dudgeon. The museum of the Wellcome Bureau is being transferred from another part of the city to the new laboratory buildings. In this museum Dr. Daukes has developed in a remarkably successful manner exhibits of infectious diseases for the purpose of visual instruction. He has divided these diseases into four groups according to the method of infection, namely, contact infections, mouth to mouth infections, excremental infections and blood infections. Photographs, drawings, transparencies, preserved specimens of vectors, models and pathological specimens are all used to create a lasting mental picture of each disease.

The men at the Lister Institute of Preventive Medicine are for the most part still engaged on problems initiated by war conditions. Dr. J. A. Arkwright showed me specimens of the supposed organism, *Rickettsia,* of Trench Fever; Dr. A. Bacot is rearing flies aseptically, has devised a method of hatching mosquito eggs within about four minutes although they have been kept in the laboratory from two to nine months, and demonstrated to me fleas containing plague bacilli; the protozoologist, Dr. H. M. Woodcock is studying some very interesting flagellates that occur in sheep and goat dung and that exhibit what appear to be sexual phenomena. Sir David and Lady Bruce had both for many years before the war been investigating trypanosomes and have extensive collections of slides and colored drawings.

At the Royal Army Medical College are the various types of laboratories to be expected in such an institution. Colonel J. A. Anderson exhibited to me a collection of models illustrating especially methods of dealing with soil pollution and mosquito control in the army. Colonel S. L. Cummins and Major Perry are both pathologists who are interested in parasitic protozoa and worms.

The subject of tropical medicine at the Royal Naval Medical College at Greenwich is in charge of Rear-Admiral Bassett-Smith, who has as his assistant Major E. L. Atkinson. Both of these men have been active in investigations of diseases due to protozoa and para-

sitic worms. Their laboratories are comfortable and well equipped.

One of the most interesting government institutions in London is the National Institute for Medical Research. Here are gathered together a number of men who devote their entire time to investigation. Among the members of the staff are Dr. C. Dobell, the protozoologist who has recently published a book on the Amoebæ Living in Man. Working with Dr. Dobell was Dr. M. Koidzumi, of Formosa, who is studying the intestinal protozoa of termites.

Another institution devoted to research is the Rothampsted Experiment Station at Harpenden near London. The subjects dealt with here include protozoology, entomology and mycology. Dr. D. W. Cutler, who seems to have been the first to successfully cultivate the amoeba of dysentery in artificial media, is now studying the protozoa of the soil in relation to soil bacteria. Dr. A. D. Imms is investigating the sensitiveness of insects to various chemicals. He finds that insects of interest to medicine are much more easily attracted by odoriferous substances than those of agricultural importance.

Several members of the staff of the Natural History Museum at South Kensington are studying animal parasites or their vectors. Dr. H. A. Baylis is building up the department of helminthology; Dr. E. E. Austen is continuing his work on tsetse flies and Dr. G. C. Robson is studying the anatomy of snails that serve as intermediate hosts of the trematodes of schistosomiasis.

Lack of time forces me to list with only slight comment other institutions and investigators who are interested in medical zoology that I was able to visit in London. These included the protozoologist, Dr. Doris Mackinnon, of King's College; Professor W. M. Bayliss, the physiologist of University College; Professor A. E. Boycott, of the University College Medical School, who has carried on researches in helminthology in Cornwall; Professor W. Bullock, the pathologist at the London Hospital Medical College; Sir Frederick Andrewes, the pathologist at St. Bartholomew's Hospital Medical School; Dr. Arthur Keith, at the Royal College of Surgeons; Dr. Broughton-Alcock and Sir Ronald Ross, at the Ministry of Pensions; Professor W. J. R. Simpson, Colonel Clayton Lane and Colonel Stewart, at the Royal Society of Tropical Medicine; Dr. G. A. K. Marshall, of the Imperial Bureau of Entomology; Dr. Thomson, at the Wellcome Historical Medical Museum; Professor R. T. Hewlett, at the Medical Research Club; Professor F. E. Beddard, at the Zoological Society of London, and many others at meetings of societies already mentioned and at the Royal Society of London and the Royal Society of Medicine. Models of sanitary apparatus and exhibits of life histories of mosquitoes, flies and other animals are on display at the Royal Sanitary Institute.

The Liverpool School of Tropical Medicine was founded in 1898. Here a large amount of investigation has been carried on in the field of medical zoology. The publications of the school include 21 memoirs, many of which embody the results of campaigns carried on in various British colonies; 13 volumes of the *Annals of Tropical Medicine and Parasitology* and several text-books on malaria. The school has just become settled in its new building which was completed in 1914 but was taken over immediately for use as a hospital during the war. The laboratories, library and museum are well designed and equipped and in the hospital nearby is a ward for tropical diseases connected with a student laboratory for clinical and pathological study. The courses in protozoology, helminthology and medical entomology extend over a period of 13 weeks. The professors who have charge of the laboratory courses also instruct the students in the clinical and pathological aspects of parasitic diseases; the school differs in this respect from the London School of Tropical Medicine. At the time of my visit Professor J. W. W. Stephens was director and taught protozoology, with the assistance of Dr. Blacklock; Professor Newsted, Mr. H. F. Carter and Miss Evans were the entomologists, and Pro-

fessor Yorke and Mr. Southwell had charge of helminthology.

Four days were spent at the meeting of the British Medical Association which was held in Cambridge on June 29 to July 2. This was a well conducted and well attended meeting and the members were enthusiastic about their work and very much in earnest. The parasitological section was in charge of Professor G. H. F. Nuttall. Papers were read and thoroughly discussed and many interesting demonstrations were provided. Dr. Nuttall exhibited his extensive collection of specimens and illustrations of ticks and insects and a large series of photographs of men who have helped to build up the science of parasitology. He also had arranged for inspection the plans for the new institute of parasitology that is now being erected at Cambridge. Dr. Leiper demonstrated new and rare parasitic worms; Dr. Christopherson showed specimens illustrating bilharziasis; Colonel Stewart demonstrated stages in the migration of ascaris through the tissues of the body; Colonel James exhibited his travelling malaria laboratory; Dr. Gaskell showed pathological specimens of malaria, and Sir Leonard Rogers demonstrated with drawings some recent remarkable cures of leprosy. Working on medical zoology at Cambridge are Professor Nuttall, Professor A. E. Shipley, Professor J. F. Gaskell, Professor Graham-Smith, and Dr. Keilin. Many of the men I had met in London, Liverpool and on the continent attended this meeting and were present at the various luncheons, receptions and dinners tendered to the members and foreign guests.

Four days were also spent at the meeting of the British Association for the Advancement of Science at Cardiff. The zoological section was well attended, but very few young men were in the audience, the supply either having been wiped out during the war or directed into other lines of work. The usual sectional meetings and social events made up the daily programs. Opportunity was afforded to become acquainted with many British scientists whose names are well known to all zoologists.

My last week before sailing back to America was spent at the Marine Biological Laboratory at Plymouth, England. Here is situated a well equipped laboratory devoted almost entirely to problems in marine biology. Work on microorganisms is being carried on by the director, Dr. E. J. Allen. Among the members of the staff is Dr. Lebour, who has published investigations on helminthology.

One can not take such a trip as that briefly outlined above without being impressed by the importance of medical zoology, both as a subject for pure scientific research and as a necessary foundation for work in medicine and public health. Countries like England, France, Belgium and Italy that are situated or have colonies in tropical and subtropical regions find it necessary to investigate the relations of parasitic animals to man because of the prevalence of these organisms in the warmer countries. The war, however, in spite of the stimulus it has given certain phases of medical zoology, has so depleted the supply of young men and so reduced the funds available for scientific work that many years will be required for these countries to regain their former productivity. The result seems inevitable that the United States must assume the leadership in this as well as in other branches of science.

R. W. HEGNER

THE JOHNS HOPKINS UNIVERSITY

THE PROBLEM OF THE INTRODUCTORY COURSE IN BOTANY

Two years ago a committee of the Division of Biology and Agriculture, National Research Council, sent to a number of botanists in the United States and Canada requests for outlines of what they would plan as the best type of introductory course in botany. There was at that time a particular reason for the enquiry because of the problems introduced by the curriculum of the Student Army Training Corps.

The response was generous and the committee soon had in its possession some forty replies. These presented such divergence of opinion as to material and method in relation

to the various conditions under which botany is taught that it seemed desirable to publish a few representative outlines and some of those showing the more radical departures from the better known types of courses. A number of outlines of high school courses in botany were also included in the series of twenty which was published during 1919–20 in five numbers of *School Science and Mathematics*.[1]

An examination of the outlines soon made clear, as was to be expected, that there is great divergence of opinion on what should be the content of an introductory course and the order of presentation of its material. Yet this situation is far from indicating chaos in the methods of teaching. It means that for the most part conditions under which courses are framed are so various in schools and colleges that there can be no standardization of the introductory course. Also the personality of the instructor as shown in the technique of his teaching is a variable factor that can never be brought within bounds. There are some teachers exhibiting a spirit for experimentation and an originality of treatment that makes their outlines of refreshing interest.

Very evident is the expressed desire to make a large part of the course a study of the life activities of plants. Morphology is generally presented that knowledge of structure may make possible a study of function. The work of the plant becomes a subject of importance and the plant as a mechanism a matter of particular interest. Few of the outlines gave special emphasis to the study of types with the end in view of developing a detailed evolutionary history. The few representatives of the lower plants are obviously selected because they are organisms of importance for what they do or because of peculiarities favorable for an understanding of cell structure or reproductive processes.

There seems to be no disposition to drop out of the introductory course drill on the life histories of higher plants to establish the significance of sporophyte and gametophyte. Except in the shortest of the outlines, alternation of generations beginning with the bryophytes has a prominent place in the course. There is significance in this desire to hold students to a critical understanding of the homologies between spermatophytes, pteridophytes and bryophytes for the problems are of the sort that call for close thinking. Also, the conclusions are perhaps the most important deductions of plant morphology.

While there is an evident desire on the part of instructors to include physiological studies the practical difficulties are admittedly great. In the large introductory courses of some universities, where classes number 200 or more, physiological work must be taught largely by demonstrations unless there is an expensive equipment and a staff of numerous and capable assistants. Outlines number 2, 5 and 11 of the published series present courses organized primarily from the physiological standpoint and are of particular interest in this connection. Most instructors open the introductory course by the way of morphology, which has the obvious advantage of presenting material upon which the student may quickly be put to work, and introduce physiology with morphology as a background.

The problems of field work are an evident source of irritation. The fact seems to be that relatively few students show much interest in names or in the natural history of plants, but they frequently are attracted to a study of structure, to the physics and chemistry of plant life, and to the discussion of fundamental biological principles. Of course the teacher of a small group in a country environment can do much more with ecology than the city teacher limited to parks and gardens, and burdened with large classes. Much may be said for optional field trips attracting only the students with a keen desire to know plants and plant associations, students in whose company on a walk an instructor will find pleasure.

[1] A limited number of reprints of these outlines are available for distribution and will be sent on application to those interested in the problem of the introductory course in botany.

The study of the outlines submitted has impressed the writer with the value of direct and printed discussion of the problems of the introductory course. The problems are perhaps best understood by the interchange of experience through the publication of outlines with the reasons for their preference. Progress will come through experimentation in methods, material and texts, experimentation that can never end since each year brings new teachers to the problems.

BRADLEY MOORE DAVIS
UNIVERSITY OF MICHIGAN,

PRESENT STATUS OF THE AFFAIRS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE[1]

IT seems highly desirable that members of the association should be kept currently informed regarding the progress made in the work of the permanent secretary's office, so that they may have a somewhat clear conception of what the association is doing and how its various aims are being carried out. To this end, it is planned to publish in SCIENCE, from time to time, summarized reports of progress and notes on matters of general interest. The present report refers mainly to the period from April 1 to October 1, 1920.

Publications.—A booklet has been prepared, including the constitution and by-laws and other information. About 23,000 of these booklets have been sent to members and prospective members. Additional copies may be obtained from the permanent secretary's office. All members have been requested to fill in the blanks on an information card and a large number of these cards have been returned. The information asked for is partly for use in the preparation of the new membership list (which will be published in the spring of 1921) and partly for the files of the office. It has been found necessary to make a charge for the new membership list since the funds of the association do not allow of its publication otherwise. This charge is $1 to members who remitted before December 1, 1920; $1.50 to members who remit later. The price of the volume is $1.50 to those who are not members.

Statement Cards.—A new series of white cards has been devised and adopted, for presenting the annual statements to members. In all cases the reverse of the billing card bears the information blanks mentioned above and each member is asked to return the card with his remittance of dues. These cards make up the information file of members' names.

Master File.—A complete card list of members has been installed and is kept continually correct. These cards show the status of each member as to dues and as to membership in affiliated academies or divisions of the association.

Application Forms.—Application for membership is now made on a buff card bearing the information blanks, these cards being inserted in the information file as soon as the new member has been elected. No sponsers are now required for application. Election can not occur until the proper remittance has been received. A special application card (blue is used by new members of affiliated societies, who are eligible to membership in the association without payment of the regular $5 entrance fee.

Invitations to Join the Association.—The campaign for increasing the membership has necessarily been somewhat restricted during 1920, on account of much other work, especially in connection with the reorganization of the office, but it will be vigorously pushed during 1921. About 9,000 invitations have been sent to newly-elected members of affiliated societies, who make application by the blue card mentioned above. A strong campaign for new members is being carried out by the Local Committee for the Chicago meeting.

Special Offer Regarding Arrearages for 1917–19.—This offer (see SCIENCE, May 7, 1920, page 470, paragraph 3) was presented to 2,175 members who were in arrears for one or more years of this three-year period. Acceptances, with payment of 1920 dues and consequent reinstatement as in good standing,

[1] From a report of the Permanent Secretary presented to the Executive Committee at its meeting in New York, October 17, 1920.

were received from 161 members. According to the by-laws, members who were in arrears for 1917 or 1918, and who had not taken advantage of this special offer, were dropped from the membership list on October 1.

Notifications and Certificates.—The engraved certificates of life-membership, membership, and fellowship have been revised, as is also true of the notifications accompanying these and the notifications of election to office. Notification forms have been prepared and brought into use for acceptance of resignation from the association and for notice of retirement from the membership list on account of arrearages for over two years.

Divisions of the Association.—The arrangements provided for the Pacific Division and the Southwestern Division have been carried out. New members in the geographical provinces of these divisions make their first payment to the division. After the first year, dues are paid to the permanent secretary's office. The divisions receive from the permanent secretary's office, the entrance fees obtained through their efforts and also $1 a year for each member in good standing.

Affiliated Academies, Etc.—Eight state academies of science have become affiliated, being those of Illinois, Iowa, Kansas, Kentucky, Nebraska, New Orleans, Ohio and Wisconsin. The Southern Education Society is similarly affiliated. These organizations collect the dues of their national members (who are also members of the A. A. A. S.), using white statement cards supplied from the permanent secretary's office but sent out by the affiliated organizations. Such affiliated organizations remit to the permanent secretary's office $4 a year for each national member in good standing in the association.

Change of Office.—The permanent secretary's office has been moved to the third floor of the Smithsonian Institution building, the new quarters being much more satisfactory than the old ones. Mr. Sam Woodley has charge of the office, with two clerks.

Addressograph Plates.—Additions have been made to the addressograph plates, so that members' addresses printed therefrom show the year of election to membership, to fellowship and to life-membership. For example, the symbol 17 denotes that election to membership occurred in 1917; 17F19 means the same, with added information that election to fellowship occurred in 1919; L19 means that the member became a life-member in 1919.

Arrangement of Plates.—The file of addressograph plates is now segregated into geographical groups, the members' names for each state, etc., being filed together. For states with affiliated academies, names of academy members are segregated, each such state thus having two alphabets. Furthermore, each group of plates is subdivided to show (*a*) those who have paid and (*b*) those who have not paid dues for current year, and (*c*) life members.

STATUS OF MEMBERSHIP (SEPTEMBER 30, 1920)

No. of members paid-up for 1920..	9,649	
No. of life members..............	353	
Total paid-up membership.......		10,002
No. of members in arrears for 1919 and 1920....................	447	
No. of members in arrears for 1920 only	938	
No. of members who still owe $2 on account of dues for 1920..	55	
Total number of members not in good standing, but whose names are retained on membership list.		1,140
Total of names on membership list		11,442

Two hundred and one new members were elected between November 1, 1919, and October 1, 1920. Approximately 400 new members have been elected since the last-named date.

BURTON E. LIVINGSTON,
Permanent Secretary

SCIENTIFIC EVENTS

STANDARDIZATION OF INDUSTRIAL LABORATORY APPARATUS

THROUGH the efforts of certain apparatus manufacturers, there met informally at the Chemists Club, New York City, on August 2, representatives of the following companies to

discuss the advisability of drawing up standard specifications for laboratory apparatus to be used in their industrial research and works control laboratories: Barrett Company, General Chemical Company, Atmospheric Nitrogen Corporation, Grasselli Chemical Company, National Aniline & Chemical Company, New Jersey Zinc Company, Solvay Process Company, Standard Oil Company of New Jersey, and E. I. DuPont de Nemours & Company.

It developed at this meeting that material savings might be expected to develop from this work. Since most of these companies are members of the Manufacturing Chemists Association of the United States, a committee composed of these members was appointed by the Manufacturing Chemists Association to pass on the proposals of the informal committee and to recommend the adoption of the specifications resulting from the informal committee's work as standard for the members of the Manufacturing Chemists Association.

Arrangements have been made for full cooperation with the Committee on Guaranteed Reagents and Standard Apparatus of the American Chemical Society, and also with the committee on standards of the Association of Scientific Apparatus Makers of the United States of America. These specifications will be considered carefully by committees of these three societies, and it is expected that they will then be published as tentative for a period of six months in order to give time for general criticism. At the end of that time the specifications will be adopted as final.

In carrying on this work an effort will be made to obtain specifications which will insure the cheapest mode of manufacture of a given instrument consistent with the duties that it must perform.

To date, three meetings of this committee have been held and considerable progress has been made. The committee desires to cooperate fully with all industries, and any communications should be forwarded to the chairman, Dr. E. C. Lathrop, E. I. duPont de Nemours & Company, Wilmington, Delaware.

NEEDS OF THE GEOLOGICAL SURVEY PROGRAM

ONE of the features of the forty-first Annual Report of the Director of the United States Geological Survey, just made public, is the statement that though, during the 40 years of its existence, the Geological Survey's policy has been to contribute material for a national plan to gain scientific knowledge of the nation's mineral resources, yet the greatest need of the Geological Survey to-day is a plan for itself—a program. The recognized function of a scientific bureau is to collect and arrange facts upon which the nation may base its plans for future development, but the Geological Survey now finds itself unable to plan adequately its own development. It lacks that assurance of continued appropriations that would encourage or warrant long-term investigations, a few of which are absolutely essential to any forward-looking program of scientific research. The increasing gap between the government scale of professional salaries and the scale prevailing in commercial employment causes a continual change in personnel that makes the administration of scientific work almost hopeless. The responsible official, in arranging to have the work done that is most needed, actually has his choice of projects determined for him by the personnel available. For each scientist of fully tested ability the choice has to be made between several pieces of work, all of which deserve immediate attention. Even less satisfactory is the situation in which an urgent call for a geologic field examination has to be met by assigning to it an untried worker. The report holds that the net result is that the Geological Survey is not fully occupying the field which is recognized as peculiarly its own. It could, however, occupy that field. With slightly increased appropriations, and especially with the declaration of intent by Congress to regard the scientific bureau as having successfully passed its probationary period, greater stability might be expected and some progress might be made in the adoption of a program fitted to the country's needs.

THE AMERICAN JOURNAL OF HYGIENE

THIS journal published by the Johns Hopkins Press and supported by the DeLamar Fund of the Johns Hopkins University will be devoted to the publication of papers representing the results of original investigations in the domain of hygiene, using the term in the broadest sense to cover all applications of the mathematical, physical, chemical, medical and biological sciences to the problems of personal and public hygiene. At least six numbers, corresponding to a volume of about 600 pages, will be issued annually, beginning with January, 1921. Investigations of unusual length will be published in a series of supplementary monographs.

Dr. William H. Welch is the editor with Dr. Charles E. Simon as managing editor. They will have the assistance of the following:

Herman M. Biggs, Health Department, State of New York.
Carroll G. Bull, school of hygiene, Johns Hopkins University.
William W. Cort, school of hygiene, Johns Hopkins University.
William W. Ford, school of hygiene, Johns Hopkins University.
Simon Flexner, Rockefeller Institute, New York.
Wade Hampton Frost, school of hygiene, Johns Hopkins University.
Frederick P. Gay, University of California.
Robert W. Hegner, school of hygiene, Johns Hopkins University.
William H. Howell, school of hygiene, Johns Hopkins University.
Edwin O. Jordan, University of Chicago.
Charles A. Kofoid, University of California.
Graham Lusk, Cornell University Medical School.
Elmer V. McCollum, school of hygiene, Johns Hopkins University.
William H. Park, Health Department, New York City.
George W. McCoy, hygienic laboratory, U. S. Public Health Service.
Raymond Pearl, school of hygiene, Johns Hopkins University.
Milton J. Rosenau, Harvard University Medical School.
Frederick F. Russell, International Health Board.
Theobald Smith, Rockefeller Institute, Princeton.
Edward R. Stitt, U. S. Naval Medical School.
Victor C. Vaughan, University of Michigan.
Charles-Edward A. Winslow, Yale University.
Hans Zinsser, College of Physicians and Surgeons, New York.

THE YALE FOREST SCHOOL

ON December 21 and 22 the alumni and former students of the Yale Forest School will celebrate the 20th anniversary of its founding. In September, 1900, this school first opened its doors for the training of professional foresters. The school was founded by Gifford Pinchot, forester in the Department of Agriculture, to provide trained foresters for employment in the U. S. Forest Service, with the ultimate purpose of administering these National Forest lands. At that time and for five years thereafter these forests were in the hands of the General Land Office of the Interior Department, but in 1905 they were transferred to the Department of Agriculture, and the personnel of the Forest Service, recruited partly from the men trained at Yale, took hold. On Mr. Pinchot's retirement in 1910, he was succeeded by Henry S. Graves, under whom the Yale School has been built up. When Mr. Graves resigned in 1919, his successor was W. B. Greeley, one of the earlier graduates of the Yale School.

Of 513 men who have received professional training at the Yale School, 97 are still employed by the Forest Service. Of these, 12 are engaged in research, and 85 in administration. Thirty-eight, nearly half, of these men are now in the office at Washington or in the seven district offices into which the National Forest administration is divided, and have direct charge of the general policies of the service in those districts. Twenty-six are supervisors, each in charge of a National Forest whose area averages over a million acres. One of these supervisors, in Alaska, controls twenty million acres.

There are now twelve forest schools which give more or less adequate professional training in forestry by devoting four to five years of schooling to this subject, and through a faculty sufficiently large to permit of subdivision of teaching and thus provide ade-

quate instruction. Of these twelve schools, ten are under the direction of Yale men, and eleven have Yale graduates in their faculties. In addition, forestry is taught as a subject at four other institutions by Yale graduates. In all, forty-one men from this institution are engaged in training professional foresters in America.

POSTBELLUM REORGANIZATION OF THE INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE

THE results of the balloting in the reorganization of the International Commission on Zoological Nomenclature have been announced as follows:

Class of 1922 (elected in 1913):
Dr. J. A. Allen, New York, N. Y.
Dr. J. A. Bather, London, England.
M. Ph. Dautzenberg, Paris, France.
Dr. W. E. Hoyle, Cardiff, Wales.
Dr. K. Jordan, Tring, Eng.
Professor H. Kolbe, Berlin, Germany.

Class of 1925 (newly elected, vice Class of 1916):
Dr. D. S. Jordan, Palo Alto, Calif.
Professor A. Handlirsch, Vienna, Austria.
Professor R. Monticelli, Naples, Italy.
Dr. E. Simon, Paris, France.
Dr. H. Skinner, Philadelphia, Pa.
Dr. L. Stejneger, Washington, D. C.

Class of 1928 (newly elected, vice Class of 1919):
Professor C. Apstein, Berlin, Germany.
Dr. E. J. O. Hartert, Tring, England.
Dr. Geza Horvath, Budapest, Hungary.
Professor Louis Roule, Paris, France.
Dr. C. W. Stiles, Washington, D. C.

No majority was obtained for the vacancies caused by the death of Commissioner Blanchard and by the resignation of Commissioner Roule, accordingly a new vote is being taken. Each class consists of six commissioners, elected to serve nine years and selected from the zoological profession of the world at large.

SCIENTIFIC NOTES AND NEWS

THE address of the retiring president of the American Association for the Advancement of Science, to be given at the opening general session at Chicago, on the evening of December 27, by Dr. Simon Flexner, director of the laboratories of the Rockefeller Institute for Medical Research, will be on "Twenty-Five Years of Bacteriology—A Fragment of Medical Research." There will be two other general sessions at the Chicago meeting planned to be of interest not only to all scientific workers and all members of the association, but also to the general public. One of these will be to an illustrated lecture on "Mount Katmai and the Valley of Ten Thousand Smokes," dealing with the volcanic region of Mount Katmai, Alaska, by Dr. Robert F. Griggs, of the Katmai Expeditions, National Geographic Society. The other will be an illustrated lecture on "High-Power Fluorescence and Phosphorescence," by Professor Robert W. Wood, of the physics department of the Johns Hopkins University.

THE freedom of the city of Edinburgh, where he was born in 1847, was conferred upon Dr. A. Graham Bell on November 30.

THE authorities of Guayaquil have ordered that a tablet be placed in the bacteriologic laboratory of the Public Health Department of Guayaquil to commemorate the discovery of the causative organism of yellow fever. The inscription reads as follows: "In this laboratory of the Public Health Service, the prominent Japanese bacteriologist, Hideyo Noguchi, member of the Rockefeller Institute, discovered the yellow fever organism, July 24, 1919."

AT the annual meeting of the American Ornithological Union held recently in Washington, Dr. Witmer Stone of the Philadelphia Academy of Natural Sciences was elected president.

HONORARY membership in the Cooper Ornithological Club has been conferred upon Florence Merriam Bailey (Mrs. Vernon Bailey). The present honorary members roll of the club contains seven names: Robert Ridgway, elected in 1905; Henry W. Henshaw, 1919; C. Hart Merriam, 1909; J. A. Allen 1910; Frank Stephens, 1912; Edward W. Nelson, 1917; and Florence Merriam Bailey, 1920. Each of these ornithologists

has been identified with the development of the ornithology of western North America.

DR. R. W. HEGNER, of the department of medical zoology, School of Hygiene and Public Health, Johns Hopkins University, has been elected a Fellow of the Royal Institute of Public Health of Great Britain.

THE Röntgen Society, London, has made the first award of the Mackenzie Davidson medal to Dr. F. W. Aston, for his paper on "Positive rays."

THE C. M. Warren Committee, of the American Academy of Arts and Sciences, has voted to make the following grants: To Professor Harold Hibbert, of Yale University, the sum of $250 to aid him in the study of the constitution of cellulose and the mechanism of the reduction of unsaturated aldehydes. To Professor James B. Conant, of Harvard University, the sum of $222.25 to aid him in the study of reversible oxidation-reduction process in organic chemistry by physical chemical means.

PROFESSOR C. J. TILDEN, of the department of engineering mechanics at Yale University, has accepted the directorship of a national movement which has for its immediate object the laying of a broad educational program for highway engineering and highway transportation, the details of which are soon to be announced.

L. SALAZAR SALINAS, director of the Geological Survey of Mexico, has been in the United States to study the methods and organization of the U. S. Geological Survey.

MR. HUBERT M. FREEMAN, associate physicist of the radio section, Bureau of Standards, has resigned to accept a position with the Westinghouse Electric and Manufacturing Company.

DOUGLAS R. SEMMES, professor of geology at the University of Alabama, has resigned, to become assistant chief geologist of the Mexican Petroleum Co., at Tampico.

THE Washington Academy of Sciences and the Botanical Society of Washington held a joint meeting on December 16, when H. M. Hall, of the Carnegie Institution of Washington, delivered an address on "Hay fever in its specific botanical relationships."

PROFESSOR FLORIAN CAJORI, professor of the history of mathematics at the University of California, addressed the Sigma Xi at Northwestern University on December 13, on "Switzerland, the mother of American geodesy."

FRANK MILBURN HOWLETT, of the Pusa Research Institute, and pathological entomologist to the government of India, has died at the age of forty-three years.

THE General Interest Session of the Section of Physics of the American Association for the Advancement of Science will be on the afternoon of December 29, when the vice-presidential address on "From Oersted to Einstein," will be given by Professor Max Mason, University of Wisconsin. This will be followed by a symposium on "Recent progress in magnetism," as follows: The electron theory of magnetism, Dr. S. J. Barnett, department of terrestrial magnetism of the Carnegie Institution. Magnetic susceptibilities, Professor S. R. Williams, Oberlin College. The ring electron, Professor A. H. Compton, Washington University.

THE first annual meeting of the American Meteorological Society will be held in Chicago beginning on December 29. The morning session will be devoted largely to papers on aerological work and the applications of meteorology to aeronautics. The afternoon session of the same day will include papers on various aspects of weather forecasting. The address of the president, Professor Robert DeC. Ward, will come at 2 P.M. on the 29th: "Climate and health, with special reference to the United States." This will be followed by an hour of discussion on physiological aspects of meteorology. The session will be closed with a number of short papers on instruments and observations. The sessions will be held in Rosenwald Hall, University of Chicago. There will be an inspection of the unusually complete meteorological station of the U. S. Weather Bureau, in Rosenwald Hall. Most

of the meteorological and climatological papers of the program of the Association of American Geographers will be presented on the 30th.

THE fifth annual meeting of the Optical Society of America will be held in Chicago, at the University of Chicago on Monday, Tuesday and Wednesday, December 27, 28 and 29, 1920. The program contains 32 titles, including the presentation and discussion of the reports of the committees on nomenclature and standards, of which P. G. Nutting is the general chairman. The reports are: (1) Colorimetry: L. T. Troland. (2) Lenses and Optical Instruments: J. P. C. Southall. (3) Optical Glasses: George W. Morey. (4) Photographic Materials: W. F. Meggers. (5) Photometry and Illumination: E. C. Crittenden. (6) Polarimetry: F. E. Wright. (7) Projection: L. A. Jones. (8) Pyrometry: W. E. Forsythe. (9) Reflectometry: A. H. Taylor. (10) Refractometry: C. A. Skinner. (11) Spectacle Lenses: E. D. Tillyer. (12) Spectrophotometry: A. H. Pfund. (13) Spectroradiometry: W. W. Coblentz. (14) Visual Sensitometry: Prentice Reeves. (15) Wave Lengths: W. F. Meggers.

THE Federation of American Societies for Experimental Biology meets at the University of Chicago on December 28, 29 and 30. The members of the Executive Committee for 1920 are as follows: Warren P. Lombard, president, American Physiological Society; Chas. W. Greene, secretary, American Physiological Society; Stanley R. Benedict, president, American Biochemical Society; Victor C. Myers, secretary, American Biochemical Society; A. S. Loevenhart, president, American Pharmacological Society; E. D. Brown, secretary, American Pharmacological Society; Wm. H. Park, president, American Pathological Society; Howard T. Karsner, secretary, American Pathological Society; Wm. H. Park, chairman, 315 W. 76th Street, New York, N. Y.; Howard T. Karsner, secretary, Lakeside Hospital, Cleveland, Ohio.

THE American Anthropological Association will hold its annual meeting at the University of Pennsylvania on December 27 and 28. This meeting was originally scheduled for Chicago in conjunction with the American Association for the Advancement of Science but decided to change to Philadelphia.

THE National Geographic Society announces the foundation of a series of Memoirs for the publication of the results of its expeditions. The new series will include both narratives, giving accounts of the activities of the expeditions, of interest to the general reader, and technical papers intended for specialists in the fields of science covered by the expeditions. The first number of the new Memoirs will be devoted to a general account of the Katmai Expeditions which resulted in the discovery of the Valley of Ten Thousand Smokes and the creation of the Katmai National Monument which embraces more than a million acres. This will be followed promptly by technical papers embodying the botanical, entomological, geological, and chemical results obtained by the Katmai expeditions. In order to complete the papers as rapidly as practicable the society has requested Dr. Robert F. Griggs to devote his full time to the completion of the work. He has, accordingly, resigned his position at the Ohio State University and will take up his residence at Washington on February 1.

THE *Experiment Station Record* reports that the various technical and cooperative organizations concerned with Danish agriculture have recently organized a Central Agricultural Council, known as the Landbrugsraadet, to promote their general interests. In addition to duties of a purely economic nature, this new institution also intends to disseminate information about foreign agriculture, especially that of a statistical nature, partly by furnishing prominent farmers directly with this data and partly through instructive articles in Danish agricultural periodicals.

IT is announced in *Nature* that the government of the Czecho-Slovak Republic has established, under the Ministry of Education, a Weather Bureau in Prague, to do for that country the work formerly done at the mete-

orological central stations of Vienna and Budapest. The new bureau will extend the meteorological service formerly conducted in connection with the K. k. Sternwarte, Prag-Klementinum (Astronomical Observatory). The director, Dr. Rudolf Schneider, is anxious to receive for the library of the bureau all the reports of observations and meteorological publications formerly sent to the Sternwarte, and he will be glad to send to other meteorological stations and offices publications of his bureau in exchange.

THE British Secretary of State for the Colonies has appointed a committee to consider and report what steps can be taken to secure the assistance of the universities in carrying out the research work which is essential to the protection of the inhabitants of the Colonies and Protectorates from disease and to the successful development of their veterinary, agricultural and mineral resources. The members of the committee are: The Right Hon. Lord Chalmers (chairman), Sir H. Birchenough, Sir J. Rose Bradford, Sir W. Fletcher, Professor E. B. Poulton, Sir D. Prain, Sir H. Read, Sir S. Stockman, and Sir A. Strahan.

WE learn from *Nature* that an Institute of Physics has now been incorporated in England and has begun to carry out its work. The object of the institute is to secure the recognition of the professional status of the physicist and to coordinate the work of all the societies interested in physical science or its applications. Five societies have already participated in this co-ordination, namely, the Physical Society of London, the Optical Society, the Faraday Society, the Royal Microscopical Society, and the Röntgen Society. The first president is Sir Richard Glazebrook, who will preside at the opening statutory meeting of the institute, which will be held early in the new year. The list of members now includes the names of more than two hundred fellows. Sir J. J. Thomson, the retiring president of the Royal Society, has accepted the invitation of the board to become the first, and at present the only, honorary fellow. The diploma of the institute is now being required from applicants for government and other positions requiring a knowledge of physics.

DR. ROBERT KNOX, in his presidential address before the Röntgen Society, London, on November 18, discussed the radiologist's need for fresh apparatus. According to the abstract in the *British Medical Journal* he deplored the lack of unanimity regarding the development of instrument design, which made standardization impossible. Nevertheless, a recognition of certain special needs was emerging—the need for increasingly powerful apparatus, for X-ray tubes capable of steady output, and for a method of exactly measuring radiation. He called upon the designers of high tension apparatus to set to work to produce more powerful apparatus. It seemed likely that radio-therapeutic work would be impeded in its advance unless a more penetrating radiation were available; at all events, if such high penetration were not required for treatment, this could only be proved after extensive experimental work for which the apparatus was lacking. At the suggestion of the British Scientific Instruments Research Association a meeting of medical men, physicists, and manufacturers had been called, and this resulted in the formation of a small committee empowered to draw up a list of questions about the design of apparatus required for radiographic and therapeutic work, and those questions were now being circulated among the radiologists of the country. Dr. Knox maintained that the development of radiological apparatus and technique called for cooperative experiment by physicists, technicians, and medical men. These problems could only be handled comprehensively in a radiological research institute with a suite of laboratories, lecture theaters and demonstration rooms. The establishment of such an institute was the object of the Mackenzie Davidson Memorial Fund. It would be directed by a general committee, with subcommittees for the physical, technical, medical and photographic sides of the work,

each subcommittee supervising a section of the institute, and all conferring together in cases of difficulty. An institute of physics was coming into being; why not an institute of radiology adjoining it or incorporated with it? At Petrograd a new institute of radiology had lately been inaugurated in a building of recent construction. If Bolshevik Russia, asked Dr. Knox, could erect an institute of radiology in the midst of its great upheaval, was the United Kingdom going to be outdone?

THE National Research Council has established the Research Information Service as a general clearing-house and informational bureau for scientific and industrial research. This "Service" on request supplies information concerning research problems, progress, personnel, funds, etc. Ordinarily inquiries are answered without charge. When this is impossible, because of unusual difficulty in securing information, the inquirer is notified and supplied with an estimate of cost. Much of the information assembled by this bureau is published promptly in the *Bulletin* or the "Reprint and Circular Series" of the National Research Council, but the purpose is to maintain complete up-to-date files in the general office of the council. Announcement will be made from time to time of special informational files which have been prepared. Requests for information should be addressed to the Research Information Service, 1701 Massachusetts Avenue, Washington, D. C.

THE Carnegie Foundation for the Advancement of Teaching distributed up to June 30, 1920, the sum of $7,964,000 in 664 retiring allowances and 245 pensions to widows of professors in 159 universities and colleges. This announcement has been made to the trustees, by Dr. Henry S. Pritchett, the president. The Foundations assets are $24,628,000. The Teachers Insurance and Annuity Association, established by the Foundation, during its first two years had provided for teachers in 213 institutions, 585 policies totalling $2,969,000 and 513 annuity contracts representing $540,000, or total expected payments of $6,480,000. The association's annuities have been adopted by thirty-four universities and colleges for all teachers desiring them, it was stated. President Hibben, of Princeton, President Vinson, of the University of Texas, President Perry, of Hamilton College and President Neilson, of Smith College, have been elected trustees to fill vacancies. President Humphreys, of Stevens Institute has been elected chairman; President Thwing, of Western Reserve University, vice chairman, and Chancellor Kirkland, of Vanderbilt University, secretary of the board.

WE learn from *Nature* that the English courts gave on November 17, a decision on the motion for an injunction to prevent Messrs. Brunner, Mond and Co., from distributing £100,000, as it was authorized to do by an extraordinary general meeting on August 5. It will be remembered that at this meeting the directors were empowered to distribute that sum to such universities or other scientific institutions in the United Kingdom as they might select for the furtherance of scientific education and research. The money was to be provided from the investment surplus reserve account. It was urged that in carrying out the resolution the directors would be acting a way which was outside the scope of the stated objects of the company, but Mr. Justice Eve ruled that the resolution came within the bounds of what was likely to lead to the direct advantage of the company, and therefore refused to make an order on the motion.

UNIVERSITY AND EDUCATIONAL NEWS

FRANCIS LYNDE STETSON has bequeathed his residuary estate, estimated at from $1,000,000 to $1,500,000, to Williams College, of which he was a senior trustee for many years and a benefactor during his life. He gave $100,000 additional to the college to establish eight scholarships for worthy students from Clinton County. The testator directs preference be given to students from the city of Plattsburg and the towns of Champlain, Chazy and Ausable in that order.

An anonymous donor has given Yale University bonds valued at over $100,000 for the department of university health.

Stanford University will have on its campus for the 1923 intercollegiate contests a stadium seating at least 60,000 spectators and costing approximately $750,000. The engineering commission, composed of Professors W. F. Durand, C. D. Marx, and C. B. Wing of the engineering departments of the university, has been requested to proceed at once with the preparation of the final plans of construction.

Samuel W. Dudley, at present chief engineer of the Westinghouse Airbrake Company, has been appointed professor of mechanical engineering on the Strathcona Foundation at Yale University.

Dr. Edwards A. Park, associate professor of pediatrics at the Johns Hopkins University, has been elected professor of pediatrics in the Yale Medical School. Dr. Park graduated from Yale with the degree of Bachelor of Arts in 1900.

Francis Marsh Baldwin, (Ph. D. (Illinois), associate professor of physiology in the department of zoology at Iowa State College, has been raised to the rank of professor. F. A. Fenton, Ph.D. (Ohio State), has been advanced to the rank of associate professor of entomology, and is acting chief of the Entomological Section of the Experiment Station, during the absence of Professor E. D. Ball, now assistant secretary of agriculture.

DISCUSSION AND CORRESPONDENCE

WRATTEN FILTERS

To the Editor of Science: My attention has been called to the fact that some biological workers have been using Wratten filters for measurements of the response of living animals to light, and that there is a possibility that results obtained in this way may be vitiated by the infra-red transmission of such filters. Measurements show that practically all these filters transmit the infra-red; the monochromatic series, for instance, transmit over 50 per cent. of the radiation of longer wave-length than 750 $\mu\mu$ which is transmitted by glass and gelatine. The filters were made for photographic work and are suitable for visual research, but no attempt has been made to eliminate the infra red, and they are quite unsuitable for work where infra red radiation may introduce errors unless that radiation is absorbed by some suitable filter such as the solution of copper chloride recommended by W. W. Coblentz, *Bulletin of the Bureau of Standards,* Volume VII., 1911, p. 655.

C. E. K. Mees

Research Laboratory,
Kodak Park,
Rochester, N. Y.

THE COST OF GERMAN PUBLICATIONS

To the Editor of Science: Mr. Howe's communication seems to deserve some further remarks. A recent letter from a prominent dealer in Leipzig tells me that prices for Germany are doubled for foreign customers and that he has no reason to believe that American dealers will be able to furnish at a lower rate. Postage is ten times higher and there is a government expert tax of 8 per cent. of the invoice. The course I took was to write the dealer not to send me anything; that in future I would not buy anything as an individual in Germany and would try to do the necessary reading through libraries, thereby dividing the cost among a number. I added that I objected particularly to the export tax.

George Dock

School of Medicine,
Washington University

A QUESTION OF BIBLIOGRAPHY

To the Editor of Science: In his well-known volume on "Fur-bearing Animals,"[1] the author, Elliott Coues, described on the authority of "Mr. Lockhart," an extraordinary act of the wolverene in the presence of man. The wolverene will squat on his haunches and shade his eyes with one of his

[1] U. S. Geol. Surv. Misc. Publ. VIII., Washington, 1877.

forepaws whilst peering at the intruder. In E. T. Seton's "Life-histories of Northern Animals," the story is repeated from Coues, but in the index the entry is credited to J. G. Lockhart. In the Encyclopædia Americana, the only J. G. Lockhart is the biographer of Sir Walter Scott.

Is it possible to get a line on this "Mr. Lockhart" who saw the wolverene on two occasions shading its eyes with a paw?

A. WILLEY

DEPARTMENT OF ZOOLOGY,
McGILL UNIVERSITY

JONATHAN EDWARDS AS A FREUDIAN

SINCE Jonathan Edwards has been brought forward as a precursor of Einstein, I wish to file a claim in his behalf as a pre-Freud Freudian. In that very remarkable record of autoanalysis, his Diary, he notes under date of May 2, 1722:

> I think it a very good way to examine dreams every morning when I awake; what are the nature, circumstances, principles and ends of my imaginary actions and passions in them; in order to discern what are my prevailing inclinations, etc.

Not only did Edwards use dream analysis for the discovery of his secret sins, but he also employed the Freudian therapeutics of frank self-examination starting with random reverie and following the thread of association until he reached the complex that he desired to eradicate by confession and sublimation. For instance, the entry dated "Saturday August 10, about sunset," reads:

> As a help against that inward shameful hypocrisy, to confess frankly to myself all which I find in myself, either infirmity or sin; also to confess to God and open the whole case to him, when it is what concerns religion, and humbly and earnestly implore of him the help that is needed; not in the least to endeavor to smother over what is in my heart but to bring it all out to God and my conscience. By this means I may arrive at a greater knowledge of my own heart.
>
> When I find difficulty in finding a subject of religious meditation in vacancies, to pitch at random on what alights in my thoughts, and to go from that to other things which that should bring into my mind, and follow this progression as a clue, till I come to what I can mediate on with profit and attention and then to follow that.

EDWIN E. SLOSSON
COLUMBIA UNIVERSITY

SCIENTIFIC BOOKS

Plant Indicators. The Relation of Plant Communities to Process and Practise. By FREDERC E. CLEMENTS. 388 pages, 92 plates. Publication 290 of the Carnegie Institution of Washington, Washington, D. C.

This is a companion volume to Dr. Clements's book on Plant Succession.[1] The aim of the present work is to show the value of the natural vegetation as indicating climatic and soil conditions, and hence, indirectly, the suitability of the areas covered for agriculture, grazing and forestry.

The earlier literature is briefly reviewed, with especial emphasis upon publications which have appeared since the plant indicator concept became definitely established (Hilgard, 1860, Chamberlin, 1877), and especially since quantitative methods began to be employed in the study of vegetation. The indicator concept is discussed on pages 28–34, stress being laid upon the superiority of the plant community to any single species. The author's point of view is illustrated by the following quotations:

> As is shown later, plants may indicate conditions, processes, or uses. The simplest of these is the first, the most practical is the last. The plant may indicate a particular soil or climate, or some limiting or controlling factor in either. This would seem to be axiomatic, but it is well known that grassland, which is typically a climatic indicator, often occupies extensive areas in forest climates. Thus, the presence of a plant, even when dominant, is only suggestive of its meaning. It is necessary to correlate it with the existing factors and, better still, to check this correlation by experimental planting, or an actual tracing of the successional development.
>
> Indicators of processes usually require a double correlation, namely, that of the plant with the controlling factor, and that of the factor with the causal process, such as erosion, disturbance, fire,

[1] Clements, F. E., "Plant Succession," Publication 242, Carnegie Institution of Washington, 1916.

etc. . . . In the case of use or practise indicators, the sequence differs in accordance with the nature of the crop. When the crop is a natural one as in grazing, the sequence is simple and direct. . . . With forage and grain crops, the sequence is more complex, partly because the species concerned are not native, but largely because the physical conditions are unnatural as well as controlled. . . .

. . . .

. . . It is necessary to recognize that every dominant can be used as an indicator of past and future as well as of present conditions. This is due, of course, to the fact that every dominant or subdominant has a definite position in succession. . . .

Bases and criteria are treated (pages 35–75) under the following main headings: The Physical Basis, The Physiological Basis, The Associational Basis, The Successional Basis, Indicator Criteria, Life-forms, Habitat-forms, Growth-forms, and Communities as Indicators.

The third chapter (pages 76–104) deals with the kinds of indicators, which are classified as Factor Indicators, Process Indicators and Practise Indicators. Among the factors considered are water, light, temperature and solutes. In this connection, the author considers lack of oxygen as the most important factor affecting plant growth in acid soils. Discussing climatic and edaphic (soil) indicators, it is stated:

The local or edaphic conditions find their expression in the seral dominants and subdominants, and the communities which they constitute. The widespread climatic conditions are reflected in the climax formation, associations, and societies.

Process indicators belong to successional rather than to climax associations and indicate the effects of disturbances of the habitat, either "natural" or brought about by the agency of man. Practise indicators show whether the land is suitable for agriculture, grazing, or forestry, and with less certainty, to what kinds of crop and methods of production it is best adapted.

A large part of the book (pages 105–236) is devoted to descriptions of the climax formations of western North America, comprising the various associations of grassland, scrubland or chaparral and forest.

Agricultural indicators are discussed on pages 237–269. Here the author develops his ideas as to the classification of the remaining public land on an indicator plant basis, stating:

. . . it should become a cardinal principle of land classification to rate as grazing or forest land all areas in which it is impossible to produce an average crop three years out of four. This would insure an adequate and permanent development of agriculture wherever possible and would warrant the introduction of scientific and economic systems of grazing, which would change it from a game of chance into an industry.

The subject of grazing indicators is treated at greater length (pages 270–335), the author pointing out that, "the simplest and most obvious indication of a plant community is that which denotes the possibility of grazing." In regard to the carrying capacity of range land, it is stated:

With respect to the plant cover alone, the carrying capacity of a grazing type is summed up in the total amount of the annual crop of forage, but the total yield must be interpreted in terms of value and utilization. Hence, it is necessary to take into account the composition of the type, the palatability and nutritive value of the dominants and subdominants, the duration and timeliness of the grazing season, and the effects of the climax cycle.

Forest indicators are discussed on pages 336–363, and the book closes with an extensive bibliography.

Field investigations extending over many years and covering practically the whole of the western United States have fitted Dr. Clements to deal with his topic in a comprehensive and illuminating manner. The philosophical point of view is predominant throughout the work, and the relation of the subject to other branches of science, as well as to practical affairs, is convincingly presented. The care used in preparing this handsome volume and its numerous excellent illustrations deserves high commendation.

THOMAS H. KEARNEY

SPECIAL ARTICLES

LONG-TIME TEMPERATURE PREDICTION

An approximate solution is here given for the probable temperature at any desired place, *e. g.*, Phoenix, Arizona, at any hour of the day such as 10 A.M. on any desired day, *e. g.*, August 12.

It is well known that the air gets warmer as the day advances and cools off during the night, repeating this rather regularly—also that it gets warmer in the spring and cools off in the fall. The normal air temperature therefore is a periodic function of the time with a 24-hour period and an annual period.

The following equation expresses the temperature T as a function of the time of the year t and the time of the day θ.

$$T = Ma + \frac{Ra}{2}\cos t + \frac{Rd}{2}\cos\theta. \qquad (1)$$

It is empirical and assumes that the annual march of the temperature can be represented by a simple cosine function, that the daily march can also be so represented and that the daily range does not appreciably change with the season.

The constants are readily obtained from the U. S. Weather Bureau for any desired locality. The first one, Ma is simply the mean annual temperature of the place in question, the second Ra/2 is one half of the Range of the annual march, or the difference between the mean daily temperatures of the hottest and coldest days of the year and the third constant Rd/2 is one half of the range of the daily march or the difference between the maximum and minimum temperatures for the day. Rd remains approximately constant for the United States, except for the arid west. For example the equation becomes for Chicago:

$$T = 48 + 25\cos t + 7\cos\theta.$$

Neither of the two marches exactly follow the cosine law. The minimum temperature does not occur exactly half way between the two maximums. As an average condition for the United States it is but 9 hours from the minimum (6 A.M.) to the maximum (3 P.M.), but 15 hours from the maximum to the following minimum through the evening. This discrepancy can be almost entirely eliminated by correcting the time from the nearest maximum on the curve in the process of changing the days and hours into degrees, *i. e.*, in the winter time consider the coldest day of the year 180° (about January 15) and February 15 would be 180 + 31° rather than counting all the way from the maximum (about August 1), 7 A.M. would be 180 + 20° and 5 A.M. 180—12°, 2 P.M. 360°—20°. Thus the normal temperature at Chicago February 15 at 2 P.M. would be

$$T = 48 + 25\cos 211° + 7\cos 340°.$$

This formula applied to the various parts of the United States for various days of the year and hours of the day gave a mean error of 2½° F. This error was due largely to the variable time of sunrise and could be corrected if one knew even approximately the time of sunrise on the day in question.

In the arid west the daily range in temperature is not constant but is a periodic function of the time, being a maximum in the summer time and a minimum in the winter time. The reason for this is that in the summer time heat is being received fast and thus the maximum temperature attained would be larger for the same time interval than in the winter when the rate of absorption of heat is slow. In this dry area the daily range is very approximately 15° in winter and 25° in summer. Assuming this range to vary as a cosine function, which it does very approximately, the equation for the arid west becomes through the addition of one more term

$$T = Ma + \frac{Ra}{2}\cos t + \frac{Rd}{2}\cos\theta + \frac{Vv}{4}\cos\theta\cos t. \qquad (2)$$

The mean difference between the actual normal hourly temperatures and those obtained through using this equation was 2.75° F.

A careful distinction should be made between the determination of the normal temperature and the determination of the actual temperature. The above formula gives normal hourly temperature and the errors are almost always less than 5° F. and the mean error only 2.5° F.

Temperatures vary quite badly from the normals. One year differs from another by about .5° F. One January differs from another by about 2° F. and one January 4 from the January 4 of another year by an average of 4° F. These departures are caused mainly by the passage of storms with their alternate warming or cooling effects. In the arid west where irrigation and dry-farming are practised (one fourth of the earth's land area is equally dry)*80 per cent. of the days are free from rain, the sky is clear most of the time and the humidity is only 50 per cent. The departures from normal are, therefore, slight. Equation No. 2 will therefore give actual temperatures aproximately for this large area.

These actual hourly temperatures differ from the normals by from 0° F. to occasionally as much as 15 or 20° F. The normal calculated from equation two differs from the actual temperatures in the arid west by 5° F. It should be remembered, however, that the same equations gave the normal temperatures correct to 2½° F.

The U. S. Weather Bureau has continuous temperature records for several hundred cities for several decades and daily maximum and minimum temperature records for several thousand more cities. The equation submitted states approximately the law of this change in temperature with the time. Its simplicity and its generality are striking.

It has practical value in such cases as the determination of early morning temperatures where heating to protect crops from frost is practised, in calculating hourly values where thermograph records have not been taken and for engineers engaged in laying concrete, in determining the normal time in the spring and fall when freezing temperatures are experienced during working hours.

Frank L. West

Utah Agricultural Experiment Station

THE AMERICAN CHEMICAL SOCIETY

(Continued)

The dynamics of the catalase reaction: Sergius Morgulis and Victor E. Levine. Many of the recent investigations on catalase are of little value because of incorrect technique and lack of appreciation of the dynamics involved. To draw proper deductions from experimental data it is necessary to select the proper method for the preparation of the enzyme and the proper preservative, and to regulate the hydrogen ion concentration of the enzyme as well as of the substrate. The shaking must be uniform and must begin almost as soon as the substrate comes in contact with the enzyme. The determination of the rate of evolution of oxygen is of greater importance than that of the amount of oxygen yielded within a given time. A ratio between the enzyme and substrate must be established such that the amount of oxygen liberated is directly proportional to the catalase concentration. For every catalase concentration there is an optimum amount of hydrogen peroxide. Increasing the peroxide beyond this amount results in a considerable progressive showing up of the reaction. The decomposition of hydrogen peroxide is a monomolecular reaction under the conditions of a constant substrate: enzyme ratio. With a constant quantity of enzyme the relation between hydrogen peroxide and the reaction velocity becomes inverse and logarithmic as soon as the concentration of hydrogen peroxide exceeds a certain limit. With a constant quantity of substrate the relation between the catalase concentration and the reaction velocity is direct and either logarithmic or linear, depending upon the presence or absence of an excess of peroxide. With a constant ratio between catalase and hydrogen peroxide the reaction velocities tend to approximate each other. Three types of curves are obtained when the reaction velocity is plotted against time: first, of rare occurrence, a curve showing a temporary increase in the value of K followed after one or two minutes by a slow falling off; second, a curve showing a continuous falling off, which is the most common and the one obtained when the catalase is in excess of the peroxide; third, a curve represented by a straight line, as is required by the monomolecular reaction, when the hydrogen peroxide is greatly in excess of the catalase.

The action of proteins on the phenol reagent of Folin and Dennis: Victor E. Levine. The phosphotungstic-phosphomolybdic reagent of Folin and Dennis is not specific for the phenolic group. The reagent can not serve as a test for proteins yielding tyrosine or hydrolysis, for all the proteins tested including gelatine give positive reactions.

That the phenol reagent is not specific has already been pointed out by Abderhalden, who found oxyproline and tryptophane to yield positive results. R. A. Gortner has also observed a positive response by indol. On further study we have found the color reaction to be given by a very large number of inorganic and organic substances, among which may be mentioned cuprous and ferrous salts, bromides, iodides, nitrites and sulfites, amines, aldehydes and ketones, carbohydrates, especially glucose, amyl alcohol, benzyl chloride, benzoyl chloride, benzidine, hydroxylamine, phenylhydrazine, phenolphthalein, haematoxylin, naphthylamine, animal charcoal, etc. Generally speaking the reagent seems to be affected by all sorts of substances possessing more or less reducing properties. In comparison to other methods the Folin and Dennis procedure for phenol in urine gives higher results, which may be accounted for by the presence of non-phenolic compounds reacting with the color reagent.

Digestibility of some raw starches: C. F. LANGWORTHY and HARRY J. DUELL, JR. In the experiments here reported, the digestibility of raw arrowroot (*Zamia floridana*), cassava, and rice starches was determined when eaten in quantities of approximately 150 grams per day by normal men. They were eaten as a constituent of a frozen custard. Raw cassava and rice starches were completely digested and no trace of them could be found in the feces. The average of these experiments on arrowroot starch varying from 65.0 to 99.3 per cent. was made 82.2 per cent. The subjects remained in normal health during the three-day experimental period and no abnormal physiological effects were noted.

Uses in biological sciences for standardized, sterile buffer tablets, and for a single sterile buffer solution covering all P_H values: PAULINE M. AVERY, R. R. MELLON and S. F. ACREE. Studies of growth, respiration, sporification, reproduction, physiology and morphology can be made with bacteria, fungi and molds, as well as with higher plants and animals, by the use of buffer tablets containing standardized quantities of desired chemicals giving definite hydrogen ion concentrations. Such tablets or mixtures may also contain standardized quantities of desirable indicators, dyes, colloids or other materials. Sterile culture media with or without agar can be given any desired acidity or P_H value by the addition of sterile buffer tablets, with or without indicators. Such P_H value may be made the minimum, optimum or maximum for the organism in order to stimulate or to suppress its growth or some other function, and this method can be made diagnostic for mixtures of organisms. By employing a suitable combination of photometer and turbidimeter or nephelometer, the hydrogen ion and indicator changes can be investigated, along with changes in colloidal conditions in solutions or agar-like gels. Such an apparatus as that devised by Sheppard[1] can be used for measuring the rate of growth of bacteria along with hydrogen ion changes, or the rate of development of spores in fungi. Colloidal and dispersed conditions in soil extracts, plant extracts, pulp liquors, milky solutions or suspensions of all kinds, and waters of lakes and streams, can be studied accurately along these lines, together with hydrogen ion concentrations. A single sterile buffer solution covering all P_H *values* when treated with acid and alkali, has been tested thoroughly and replaces the five or six solutions used by other workers. Such a single buffer solution and the standardized buffer tablets simplify the chemical side of exact researches in biology to such an extent that the methods can be used without chemical control by the biologist and consequently save his time for use in his own research field.

On the ionization constants of glycerophosphoric acid and the use of carbohydrate phosphates as buffers and nutrients, especially in culture media: PAULINE M. AVERY, R. R. MELLON and S. F. ACREE. Glycerophosphoric acid has ionization constants about $K_1 = 2.5 \times 10^{-7}$. These values are so close to those of phosphoric acid that the latter can be replaced as a buffer to advantage for several reasons. Glycerophosphates, sucrose and mannite phosphates and others are sources of carbohydrate food as well as of phosphorous. Over 20 organisms, including tubercle bacilli, have been grown on such buffered glycerophosphate media adjusted to different P_H values. The sodium and other glycerophosphate salts can be made and kept in anhydrous form, easier to handle and weigh than sodium phosphate. The glycerophosphate titration curve is sufficiently close to that of phosphates to replace it in all work when corrected. The calcium, magnesium and other salts of glycerophosphoric acid are soluble in contrast with the insolubility of the phosphates and can be used to study the effect of such metallic ions on growths and other func-

[1] *J. Ind. Eng. Chem.*, 12, 167.

tions, and on all kinds of catalytic reactions in pure and industrial arts. In beef-broth-peptone media, for example, the glycerophosphates do not give the troublesome precipitates formed by phosphates, and can therefore be added in the form adjusted sterile tablets or solutions to warm sterile media, with or without agar; the resulting medium is buffered, adjusted, clear and sterile for immediate use. The glycerophosphates can be sterilized in solid or liquid condition without appreciable decomposition. Similar reports will soon be made on other carbohydrate phosphates.

Hydrogen electrode measurements of the acid and basic ionization constants of asparaginic acid and its value as a buffer and nutrient material in culture media: J. H. Hopfield, J. B. Halstead, Marguerite A. Brennan and S. F. Acree. The hydrogen ion concentrations of solutions of $M/50$ asparaginic acid vary from 10^{-16} to 10^{-12} when the asparaginic acid is treated with acid and alkali varying from two mols of the former to three mols of the latter. Between $C_H = 10^{-6}$ and 10^{-9} there is a sharp inflection in the titration curve because of the completion of the neutralization of the stronger acid and the beginning of the neutralization of the second carboxyl. From the complete titration curve and the ionization values of the salts the constants $K_{a_1} = 1.1 \times 10^{-4}$, $K_{a_2} = 1.4 \times 10^{-10}$ and $K_b = 1.2 \times 10^{-12}$ are calculated. These are in good agreement with the values of K_{a_1} and K_b obtained by conductivity, catalysis and hydrolysis methods. The value of K_{a_2} is new and is lower than the value of $K_a =$ about 10^{-9} for asparagin, as expected for an acid salt. In another article we have shown that the inflection curves of asparaginic and phosphoric or pyrophosphoric acid mutually annul each other, and make such mixtures very fine buffer materials as well as nutrients in media for bacteria and fungi.

The nitrogenous constituents of condensed milk as compared with fresh milk: A. W. Homberger and B. Mathin.

The buoying up of the equilibrium of milk salts during meat treatment: Harper F. Zoller. The precipitation of calcium from solutions of milk salts, prepared in accordance with the composition and concentration occurring in the average of normal cows milk and at the reaction of normal milk, was followed quantitatively and with the hydrogen electrode during the effect of temperature. The loss of calcium was progressive with the time and intensity of heat treatment. The hydrogen ion concentration proportionately with the removing of the buffer material (phosphates) by the calcium. Doubling the quantity of citrates above normal although not changing the initial pH of the solutions greatly reduce the precipitation of the calcium phosphate and at the same time maintained a higher final pH. Lactates and malates acted likewise. This serves to aid in explaining how the lactic souring of milk may increase its stability towards heat.

Hydrogen electrode study of the curdling in casein solutions at high temperatures: Harper F. Zoller. When solutions of pure Hammarsten casein in carbonate free NaOH or KOH are heated in sealed tubes to temperatures ranging from 118° C. to 135° C. a precipitation of curd takes place, the formation of which is dependent upon the hydrogen ion concentration and the duration of heating. The casein solutions contained no calcium. All of the caseinate solutions remained clear, whose initial hydrogen ion concentration is less than 3.16×10^{-7}, (pH 6.5) although the solutions had been heated to 135° C. for forty minutes. There is a regular heating period of from 0.18 to 0.54 pH corresponding respectively to solutions of initial pH of 5.78 and 8.26. The precipitated curd is soluble in acids and alkalies and resembles the curd made from sterilized milk or milk heated to high temperatures as described by the author in a previous communication. The term β casein is suggested for this product to differentiate it from the products obtained by Lacquer and Sackur from dry casein. The significance of this phenomena in connection with the coagulation in evaporated milk is discussed.

Chemistry of digitalis: H. C. Hamilton.

Charles L. Parsons,
Secretary

(*To be continued*)

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, DECEMBER 31, 1920

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

TWENTY-FIVE YEARS OF BACTERIOLOGY: A FRAGMENT OF MEDICAL RESEARCH[1]

IMMUNITY

JUST a quarter of a century ago, that is in 1895, the announcement was made at the 67th meeting of the German Society of Naturalists and Physicians that diphtheria, one of the most severe and fatal diseases of mankind, had been conquered by means of an antitoxin. This great event is a landmark, not alone in the history of medicine, but also in the history of the world, and it provides a high peak of achievement from which the growth of bacteriology may be viewed. In order that we may follow the growth with understanding, it is necessary, at first, to cast a glance backward before we begin on the narrative, the aim of which is to bring us to the state of knowledge of bacteriology existing in our own day.

Since disease is so universal a phenomenon and communicability from individual to individual so obvious an incident of its epidemic prevalence, the conception of a *contagium vivim* or *animatum* and hence of an invisible form of life as the initiator of the condition, can be traced far back in the written records of human events. And yet it was not until about 1850 that a microscopic body, which we would now call a bacterium, was actually detected in the blood of a sick animal. The anthrax bacillus, as it has since been named, which is now recognized as the inciting microbe of splenic fever, was destined to play a leading part in the development of the future science of bacteriology, but at this early period its full meaning was not perceived. When, however, in 1863 Davaine succeeded in communicating splenic fever to a

[1] Address of the president of the American Association for the Advancement of Science, Chicago, 1920.

healthy animal by the direct inoculation of blood containing the anthrax bacillus, the science of bacteriology may be said to have been born.

The dates are significant to one who wishes to follow the march of events which brought the greatest master of all, Pasteur, into the field of microbiology and led him on to the study of the infectious diseases, first of animals and then of man. For on looking backward we find that coincidental with Davaine's epochal experiments, Pasteur was already engaged on those studies of fermentation and putrefaction which were not only to set our conception of those processes on a secure biological foundation, but as an important side effect were to demolish, once and forever, the elaborately constructed but insecurely based doctrine of the spontaneous generation of microscopic forms of life.

For Pasteur it was but a step, although for us one of the highest importance, from the studies in fermentation and putrefaction to those on the infectious diseases in which, indeed, the great triumphs he achieved consist far less in the detection of new kinds of microbes to which the various contagious diseases might be described, than in his fundamental discoveries in immunology, or the science of the specific prevention of disease.

This work in the field of immunology, first opened to experimental investigation by him, is the aspect of Pasteur's labors to which I wish especially to direct your attention, since it forms the connecting bond between the earliest and thus the oldest, and the present and thus the latest discoveries in a field in which medical science has come to secure some of its most notable successes. There can be no doubt that the discovery in 1880 of the artificial immunity to fowl cholera came not as a direct incident, but rather as an accidental circumstance to the experiments being pursued. In after years Pasteur loved to point out the importance of the "prepared mind" as a requisite of the investigator, in order that he may seize hold of and utilize in respect to a question propounded by experiment what, viewed superficially, appears to be only an indirect and misleading answer. The advances leading rapidly from the artificially induced immunity in fowl cholera to the dramatic and historically and economically important immunity in anthrax and to the humanly important immunity in rabies, involved no strictly new conceptions on Pasteur's part. They consisted merely of the carrying forward of the ideas, often ingeniously modified, derived from the study of the sources of the condition of immunity in fowl cholera.

But should we inquire to what order of events already known this phenomenon of artificial immunity belongs, we should say at once probably to the order having to do with the Jennerian vaccination against smallpox. As every one knows, vaccination against smallpox consists in the utilization of human smallpox material which has become modified by passing through the cow, in which it sets up the condition named cowpox. When this modified microbic virus of the disease is returned to man, a mild form of smallpox is induced, which suffices through a term of years to protect the individual vaccinated, so-called, from infection with the more active or virulent smallpox virus.

The significance of the new observations was grasped by Pasteur and related to Jennerian vaccination. His great discovery then consisted in the determination that pathogenic or disease-producing microbes may be modified otherwise than by passing through foreign and relatively insusceptible animal species, and that such simple agencies as long cultivation *in vitro* (fowl cholera), high temperatures and therefore non-optimal conditions of growth (anthrax), and partial drying of the animal material carrying the microbe (rabies), would suffice so to modify and attenuate the respective microbes that upon inoculation they set up not the severe, but only mild states of infection, from which not only does recovery ensue, but the restored animal is enduringly protected from the ordinary and often fatal attacks of a disease.

Looking backward from our present higher position of vantage, we may discern certain

minor imperfections in this fundamental work on artificial immunity. For example, it would now appear that the so-called attenuated cultures of the bacillus of fowl cholera, used for purposes of immunization, were not so much attenuated as actually dead, and that the material inoculated consisted of a mixture of dead bacilli and their metabolic and disintegrative products. In other words, it seems that Pasteur without perceiving it had discovered not only a principle of wide applicability in inducing artificial immunity, but a general method of utilizing dead bacteria as vaccines, and one which in more recent times has been widely resorted to in preventing outbreaks of typhoid fever, cholera, and some other diseases.

In 1882 antirabic inoculation was perfected. Pasteur had, of course, reflected deeply on the sources of the immune state and in explanation of it he inclined to the view that the basis of the phenomenon was a nutritive condition. He conceived that in the course of that form of microbic development within the body which came to a spontaneous end and left the individual protected, certain essential foodstuffs were consumed, in virtue of which the same variety of microbe could not later gain another foothold. Time has not upheld this simple conception; but when it was formulated the subject matter of bacteriology was still too fragmentary and scanty to point to the deeper underlying chemical and biological processes involved. Indeed, nearly ten years elapsed until Behring's discovery of antitoxic immunity brought about a revolution in the prevailing ideas and opened up new and fascinating vistas of research.

We have now reached the period at which the German school of bacteriology, led by Robert Koch, has arisen beside the French. Koch's career in science was meteoric. From an inconspicuous country practitioner he became, in the period beginning about 1880, the outstanding world figure in bacteriology. But his greatest work was completed in relatively few years, although that of his pupils has continued up to and is still potent at the present day. It is informing to reflect that just as Davaine made the first signal advance in the experimental inoculation of disease with the anthrax bacillus, and Pasteur the first dramatic demonstration of the practicability of protective inoculation with bacterial cultures also with that bacillus, Koch rose into fame through the study of its life history by direct observation under the microscope. But Koch's greater contribution to bacteriology consisted of a method of cultivation so perfected that pure growths of bacterial species were readily obtainable. The consequence was that in a very brief period of years a whole host of pathogenic bacteria or incitants of diseases of man and animals was secured, among which were the highly important bacilli of tuberculosis, cholera, typhoid fever, diphtheria, tetanus, dysentery, plague, meningitis and many others.

Up to the period we are now considering, all the diseases of microbic origin thus far investigated successfully belonged to the class in which the bacteria invaded the blood and the internal organs. But now we are about to learn of another kind of disease induced by a class of bacteria which are peculiar in that they do not migrate throughout the body but remain fixed in a special tissue or part, where they multiply and secrete a poison which finds its way first into the lymph, then into the blood and the organs generally. This latter class of microbes produces its effects to which we give the name of disease, and of which diphtheria and tetanus are examples, through the operation of a poison, peculiar to each, and in each instance attacking by preference certain definite organs or parts of them. Thus the poison elaborated by the diphtheria bacillus selects especially the lymphatic organs, heart and nervous system for its action, and the tetanic poison the nerve cells governing muscular contraction.

We have now returned by a route somewhat circuitous perhaps to the point from which we started, namely diphtheria and its antidote. But in the course of the journey we have taken, new points of view have been gained which, as will appear, are to transform en-

tirely the outlook upon the problems that bacteriologists set themselves to solve.

Behring and Kitasato chose the task of inducing in animals immunity, to diphtheria on the one hand and to tetanus on the other. This was a logical undertaking and one clearly in the spirit of the times. Both men had a strong interest in the quest. The one (Behring) was deeply engaged in the investigation of the chemical disinfectants and conceived ideas of modifying bacterial growth through these agents, as Pasteur had succeeded in accomplishing with physical means. The other (Kitasato) had succeeded where his predecessor and the discoverer of the tetanus bacillus, Nicolaier, had failed in obtaining pure cultures of that microbe. Moreover, the restricted local development of the two bacilli and their generally poisonous or toxic effects aroused in them an eager interest intensified by the epochal discovery just made by Roux and Yersin that the toxin of the diphtheria bacillus was readily separable from the bacilli producing it and could be obtained by precipitation in, it is true, an impure state but one in which its poisonous action was preserved. Indeed, so appalling did its poisonous effect prove to be that these investigators could not imagine any other non-living substance than an enzyme which could exhibit such active properties.

The isolation of the diphtheria toxin, quickly to be followed by the similar isolation of the tetanus toxin, was an event of capital importance and reacted at once vigorously on the chemical aspects of bacteriology just struggling into the light. The immediate effect of the study of the new poisons, called toxalbumins, was to discredit a whole series of pure, crystalline basic substances obtained not long before from a wide variety of bacteria, to which the name of ptomaines had been given. Many of the ptomaines were possessed of poisonous properties; but what was disconcerting was that very diverse bacteria might yield identical chemical compounds which, therefore, lacked the property of specificity, an essential quality of bacterial activity. The toxalbumins, on the other hand, which even to this day have not been secured in a chemically pure state, exhibit in perfect degree the property of specificity and display all the power for evil and all the potential possibilities for good which their original and respective bacilli possess; and although no method of chemical identification of their special nature is available, yet their pathological effects and immunological activities serve readily and accurately to distinguish one from the other and to indicate their origin.

The rendering of animals immune to diphtheria, on the one hand and to tetanus on the other, proved a difficult but not impossible task. The method adopted was to admix disinfectant chemicals, of which the one finally selected was iodin trichlorid, with the bacilli to be injected under the skin of animals, or with the contents of the culture flasks at the end of the incubation period. Obviously, the intent was to moderate the poisonous action of the inoculated material, in the hope that a mild and not fatal infection would be induced from which recovery would follow leaving the treated animal immune.

The experiments were sometimes successful, and as such seem merely to illustrate a variation of the Pasteurian method of inducing immunity which, as we saw, was not distinct in principle from the Jennerian vaccination. But the break with the past was none the less imminent, for Behring's next act was not to speculate on the theory of immunity but to perform a decisive experiment. It is to be kept in mind that in the poisons or toxalbumins of diphtheria and tetanus, we possess the essentially active ingredients of the respective bacilli and that the body attacked does not succumb to the invading bacilli but to the action of the toxins. Hence, Behring turned to the blood of the immune animals and tested it for neutralizing power against the poisons, and discovered antitoxin; he injected the blood of an immune into the body of a normal animal prior to inoculation and discovered passive immunization; and finally, he injected the blood of an immune animal into animals previously inoculated with the bacilli

of diphtheria and tetanus, and discovered serum therapy. The day for speculation on what constituted the immune state had now definitely passed, and the time had arrived for subjecting the phenomenon to experimental study.

The fluids or "humors" of the body, to employ a term made respectable by age, as represented by the serum of the blood, had been shown to carry the immunity principles, but what part did the cells of the body play in the process? Both fluids and cells were now submitted to rigid and ingenious scrutiny, and about them an immense literature has grown up. Soon the students in the field divided into two camps, namely, one led by Ehrlich, defending the humoral doctrine, the other led by Metchnikoff, urging the cellular or phagocytic doctrine. The conflicts which raged about these concepts were always animated and sometimes even bitter; but the ultimate effect was to extend rather than to retard and confound knowledge. We are moving now in more peaceful times, the heat of the earlier conflicts having largely subsided, and it may be stated that neither the one nor the other doctrine finally triumphed, but that the humors or fluids of the body on the one hand and the cells on the other have come to be recognized as the active participating factors in the immunity process, the one complementing the other. Where the phenomenon is one purely of the neutralization of a poison or toxin, the fluid portion of the blood suffices; where also the process is relatively the simple one of acting on and dissolving a bacterial cell, there also the fluid may suffice, although an essential element in the process may have been supplied by the white blood cells at the moment of their withdrawal from the body. But where the bacteria are not readily disintegrated and dissolved, there the phagocytes of the blood and tissues come into play and, through their power of engulfing these particles, operate as one of the body's main defenses against infection.

The unravelling of the intricacies of the immune state, following upon the work of Behring, has brought about a sudden and unprecedented enlargement of the scope of bacteriology, as well as supplied a wealth of new facts of which many have permanently enriched practical medicine and opened new territory to profitable exploration. It may suffice at this point merely to mention certain of the devices for diagnosis and means of preventing or of treating disease, which are the immediate heritage of studies in the field of immunity, of which many have come not as direct fruits, but as invaluable by-products of the search. In this manner have been secured the Widal test for typhoid fever, the Wassermann and allied reactions, the hypersensitive or Schick test for diphtheria susceptibility, the hypersensitive reaction as now applied to the detecting of the offending agency in hay fever and allied states, the refinements of bacterial vaccination in the prevention and sometimes in the treatment of disease, and so-called specific serum therapy. Moreover, these studies have placed in the hands of the bacteriologist a powerful instrument for detecting, through immunity reactions carried out in test tubes, or the animal body, new varieties of pathogenic or disease-producing bacteria and of investigating more closely and sorting out groups of pathogenic microbes not hitherto subject to analysis. Finally, the immunity reactions, as they are generically named, have been found not to be restricted to bacterial cells and poisons, but to apply to a wide variety of cells and their products. For it should be recalled that in the decade immediately succeeding the discovery of antitoxin, agglutinins, precipitins, bacteriolysins, cytotoxins, hemolysins, complements, chemotaxis, anaphylaxis, and the minutiae of phagocytosis were discovered and became the objects of animated and often feverish and sometimes controversial but always profitable investigation.

It happened also and quite naturally and logically that this should be the heyday of hypotheses concerning the biological basis of immunity and the manner in which interaction takes place between toxin and antitoxin inside as well as outside the body, and of the englobing of bacteria and other bodies by the blood and tissue cells, as well as the nature of

the combinations and permutations and reactions between the more complex bacteria and cells in course of their immunological transformations. And thus there came to be elaborated the side-chain hypothesis of Ehrlich, which vied with the phagocytic theory of Metchnikoff as well as with the adsorption theory of Bordet and the physico-chemical theory of Arrhenius. And if in our busy lives of to-day we think less of receptors and amboceptors, of complements and complementoids, haptophores, and toxophores, and limit ourselves somewhat more closely, perhaps even a little too exclusively, to the observed fact itself, yet it is well that we do not forget how great at the time was the stimulus to research and how rich the booty which accrued from those labors tinged with the radiance of the real scientific imagination of an Ehrlich, a Metchnikoff, and a Bordet.

Not all the high expectations of practical benefit to follow from these discoveries have been realized, but sometimes the very failures have been turned to account in opening up new, or illuminating old, avenues of progress. In this connection it is instructive to recall the early pronouncement of Behring made two years after the discovery of antitoxin, and while he was under the influence doubtless of that great contribution:

"The present state of the immunity question," he says, "may be defined as follows: Thus far no generally applicable explanation for natural immunity has been forthcoming. But of the artificially produced immunity it may be said that the precise study of a number of examples has so far advanced our knowledge that we may assert with confidence that the immune state arises from a peculiarity of the blood and, indeed, of its cell-free portion; in no instance in which a sufficiently high grade of immunity has been attained in an animal species, easily susceptible to the infection in question, has the blood withdrawn from the body failed to show evidences of the presence of the immunity-conferring substances."

In this statement will be perceived the extreme humoral view of the origin of immunity, which subsequent investigators failed to uphold. But he continues in a prophetic vein, unfortunately likewise destined not to be wholly fulfilled.

"With the achieving of this standpoint the next step in the winning of specific curative agents for the infectious diseases is clearly outlined: all that is required is the induction in a susceptible animal species of a high degree of artificial immunity, and then to test the blood for the presence of protective and healing substances."

Time has exposed the fallacy of this over-confident attitude and taught the distinction between the two varieties of infectious disease and their corresponding immune states, according as their main effects and symptoms arise from the toxalbumins or poisons we have been considering, or the intimate presence within the organs of the microbes themselves. The former variety chances indeed to be in the minority, and hence it has come about that the diseases to be successfully combated by antitoxins are few in number, while those in which the microbes penetrate deeply into the body and which poison its tissues by means of so-called endotoxin, are far more numerous. The latter class includes such important diseases as tuberculosis, typhoid fever, meningitis, plague, cholera, the septicemias, and still others. And yet the failures have been only partial, and success has been and is still being won against odds which were once considered insuperable.

What is striking is the capriciousness with which the microbes themselves or their endotoxins lend themselves to the making of therapeutically effective serums, as contrasted with the ease and certainty of action in this respect of the toxalbumins. All the latter seem capable of yielding abundant antitoxins, and this independently of their precise source, since it happens that toxalbumins resembling those of bacterial origin exist also in the higher plants —as in the castor and jequirity beans—and in the venoms of reptiles and insects. On the other hand, it has not thus far been found practicable to fashion curative serums for tuberculosis, typhoid fever, plague, cholera,

etc., while success has been achieved in the instance of epidemic meningitis, and very hopeful results have recently been attained in the case of pneumonia.

In meningitis the success is linked with the recognition of a second principle of action, namely the advantage to be derived from what may be called the local specific treatment of a disease, or the bringing of the healing serum into direct and intimate relation with the seat of the infection itself. Since in epidemic meningitis it is the membranes surrounding the brain and spinal cord and those more delicate ones lining the cavities of the ventricles of the brain which are the seat of infection, it has been found easily possible, through a simple and safe procedure, to inject the serum into the cavity of the spinal meninges, whence it is quickly distributed over all the membranes of the brain and cord. It may be of interest to remark that it is not practicable to reach the inflamed membranes with the serum by way of the blood, since nature, in order to protect the sensitive nerve tissues from injury by any chance deleterious substance in this fluid, has interposed an impenetrable barrier, the choroid plexus, between the circulation and the cerebrospinal fluid which bathes and sustains the nervous organs, and which is itself elaborated from the blood by this plexus with an accuracy of selectiveness highly remarkable.

In pneumonia again a beginning success has been achieved through a finer discrimination of specific kinds among the pneumococci, the inciting microbes of the disease. This distinction is independent of ordinary physiological and cultural characters displayed by the bacteria, which do not serve to bring out the underlying specific properties of each, and has been accomplished by means of the so-called immunity tests carried out in test tubes or in the animal body. The gain to practical medicine from the detection of the fundamental differences subsisting between the three main types of pneumococci existing in this country has been very great. Already a curative serum for one of the specific types of pneumonia has been secured, and through its application many lives have been saved; while beginnings have been made in respect to vaccination against the disease when, as sometimes happens in institutions and in communities, epidemics prevail and claim many victims, as occurred in the Army training camps during the measles epidemics of 1917–18.

Thus we have learned that the immunity reactions, or the effects on bacteria and their poisons, of the fluid and cells of the body as modified by the process of artificial immunization, provide more delicate and precise means of discriminating bacterial species than the qualities of form, growth appearances and physiological activities, and more accurate methods of distinguishing poisons than the most refined chemical analyses; and we shall learn a little later in connection with the distinct but related hypersensitive or anaphylactic state, that the prepared and sensitized animal body responds to infinitesimal amounts of protein matter according to its specific origin, in a manner not otherwise determinable and far beyond the most delicate laboratory test which the chemist has invented. The animal body thus artificially prepared, or as sometimes happens naturally sensitive, acquires an appreciation of the inner constitution of the protein molecule, classifying it, as it were, not only according to its ordinary chemical nature, but according to its species origin.

The immunity reactions we have considered are not artificial creations, since as we now know, they are the very processes which nature employs in her unaided efforts to abate infections, and when need be, to adopt the body to foreign proteins. The spontaneous recovery from infectious disease, by which is meant merely that the body by its own power overcomes the microbes and their poisons, depends upon the setting into motion of the series of operations through which immunity responses in fluids and cells are insured, precisely as has been described in the event of an artificial immunization. Hence in our efforts at serum therapy we aim merely to aid "nature," by introducing, as it were, into the beset body the finished immunity products artificially pro-

duced in healthy animals; and in protection by vaccination, success is assured only to the extent to which the healthy body has been compelled to prepare the specific immunity substances and to hold them ready at hand to combat the entrance through its outer gateway of, for instance, such microbes as those inciting typhoid fever and smallpox.

That it is through the prowess of the body itself, and not the skill and art of the physician, that recovery from infectious disease takes place, had already become evident to the ablest physicians of nearly one hundred years ago. It is true that they could form no real conception of the manner in which the cure was brought about, but in admitting the existence of a class of maladies which Jacob Bigelow in 1835 called the "self-limiting diseases"[1] this innate faculty of the organism to overcome infection was recognized. It may be of even more than historical interest to reprint here the pregnant paragraph in which Bigelow expresses this view:

> This deficiency of the healing art (he is now writing of the advances in knowledge of the structure and functions of the human body in contrast to the lagging behind of the science of therapeutics, or the branch of knowledge by the application of which physicians are expected to remove diseases) is not justly attributable to any want of sagacity or diligence on the part of the medical profession. It belongs rather to the inherent difficulties of the case and is, after abating the effect of errors and accidents, to be ascribed to the apparent fact that certain morbid processes in the human body have a definite and necessary career, from which they are not to be diverted by any known agents, with which it is in our power to oppose them. To these morbid affections, the duration of which, and frequently the event also, are beyond the control of our present remedial means, I have, on the present occasion, applied the name of the *self-limited diseases;* and it will be the object of this discourse to endeavor to show the existence of such a class, and to inquire how far certain individual diseases may be considered as belonging to it.

ANAPHYLAXIS

Allusion has several times been made to the hypersensitive state which is often regarded as the opposite of the immune condition. Because the latter is conceived as protective and hence is spoken of as being prophylactic, the former in turn has been named anaphylactic. The obvious distinction between the two conditions is simply defined by the statement that while the immunized animal shows a greater degree of resistance to a second inoculation of the materials used for immunization, the anaphylactized animal on the contrary shows a heightened susceptibility.

The history of anaphylaxis illustrates the manner in which the rapidly growing knowledge of immunity reacted on the appreciation of this condition. It now appears that the physiologist Magendi, who flourished in the first quarter of the nineteenth century, first noted that an animal which had borne without apparent effect one injection of a quite harmless protein such as egg white, reacted severely to a second injection of the same kind of material given after an interval of days. No further contemporary attention seems to have been given to this isolated incident, and it was not until 1894 that the speaker chanced again upon the phenomenon. He was engaged upon a study of the pathologic action of the toxalbumins, and his attention was attracted by recent experiments on the similar globulicidal (or red blood corpuscle destructive) action of certain alien blood serums, such for example as the serum of the dog for the red globules of the rabbit. Since animals could be rendered immune to the toxalbumins, the attempt was made to make rabbits immune to dog's serum, but without success. On the contrary, it was found that animals which had withstood one dose of dog's serum succumbed to a second dose given after the lapse of some days or weeks, even when this dose was sublethal for a control animal.

Again the observation fell on stony soil, as indeed subsequent ones were destined to do a few years later and, as it now appears, chiefly because knowledge of and interest in the general subject of immunity had not progressed far enough at that period to present to the contemplation of the "prepared mind," to use

[1] Jacob Bigelow, "Discourse on Self-limited Diseases," Boston, 1835.

Pasteur's phrase, the sharply contrasted hypersensitive state.

But the time for the systematic investigation of the phenomenon was approaching, for between 1902 and 1904, Richet and his pupils had their attention arrested by an extraordinary incident, as it then seemed. In undertaking to effect immunization with certain poisonous proteins of animals, they found that instead of inducing resistance, they induced hypersensibility. To this latter condition they applied the name anaphylaxis. Although as it subsequently turned out, the idea involved misconception of the nature of the process, yet these studies stand forth illuminatingly as recognizing for the first time the dependence of the hypersensitive state upon a preceding injection of a given protein substance and the necessity of an incubation period covering a number of days between the injections, in order that the sensitive condition might be ushered in. That the sensitizing effect was of the nature of a general biological reaction of the animal body to the parenteral introduction of natural proteins into the body, without reference to their primarily poisonous character, came to be appreciated a little later as the result of observations made on rabbits and guinea pigs injected and then reinjected with horse serum, as well as with other innocuous proteins. In order to arouse the reaction of immunity in the animal body, some degree of primary poisoning of the cells, as with bacteria, their metabolic products and similar substances originating in other varieties of living beings, must be accomplished; while the sensitive state arises from the interaction of the animal body with any native protein substance whatever which finds its way directly or indirectly into the blood.

From the many investigations which now ensued, it appeared that while many kinds of warm blooded animals are subject to the condition, yet the most striking, because most uniform and dramatic effects are yielded by the guinea pig, which has since become, as it were, the "classical" animal for observing and studying anaphylaxis. The reason for this choice arises from the circumstance that in the guinea pig a sensitization of the smooth muscle fibers occurs, so that on reinjection of the original protein, among other effects, a contraction of the lining membrane of the bronchi takes place, which by closing their lumina and excluding air, quickly causes death from asphyxiation. Moreover, the guinea pig has proved exquisitely responsive to sensitization, so that minute quantities, measured even in fractions of milligrams, of pure native proteins suffice to induce a specific hypersensitive condition, whence it has followed that the prepared guinea pig has been found suitable for the investigation of the ultimate chemical relationships, not otherwise observable, which subsist between native proteins.

Profoundly different as are the obvious features of the anaphylactic and immune reactions, yet certain of the fundamental conditions governing both coincide. It will be recalled that in arousing immunity in animals by artificial means, certain new substances of the general nature of antipodes, or as technically named, antibodies, are made to arise in the blood of the treated animal; and it now appears that in the course of sensitization of animals, antibodies to the proteins injected also develop. In both instances the material originally injected, whether primarily poisonous or not, if active, belongs to a class now called antigens, that is generators of antibodies. The expression of the immunity reaction, in its simplest terms, consists of a chemical or physico-chemical union between the original antigen and the manufactured antibody, taking place in the body or in a test tube, through which the primarily poisonous antigen is rendered innocuous. In other words, the immune antigen-antibody complex is a harmless compound.

In a similar manner the sensitizing antigen and induced antibody unite in anaphylaxis, but the product of the union is essentially different from the one just considered, in that it is highly injurious, and the effect of the antigen-antibody complex is not to protect, but to poison the animal. The basic distinction between the immune and the anaphylactic condition, as described, is further enforced when

we recall that the original toxic protein used to immunize is detoxicated in the course of the immune reaction and the original non-toxic protein used to sensitize is endowed with the property of intense toxicity in course of the latter reaction.

As in the instance of the immune state, a still undecided controversy is going on as to whether the hypersensitive condition depends upon humoral or upon cellular factors. There is no doubt that the anaphylactic antibody exists free in the blood, and hence that a normal animal can be rendered passively sensitive by the infusion of blood derived from a sensitized animal. It is equally true that the anaphylactic response is in part a cellular one, as in the instance mentioned of the bronchial musculature stimulated to contraction. By appropriate experiments it can be shown that organs containing smooth muscle taken from sensitive animals, exhibit the equivalent of the anaphylactic reaction even outside the living body; and also that coincidentally with the appearance of the "shock" of the reaction in the guinea pig, the blood becomes incoagulable.

Hypersensitiveness may exist independently of purposive artificial sensitization, and some of the most important examples of that condition have been observed in man. Because of their size, perhaps for other reasons, human beings even when sensitive react to the parenteral injection of native proteins less severely than the smaller animal species. And yet lamentable instances, if very few in number, of serious or even fatal anaphylactic effects have been observed in man. These have occurred especially in connection with the therapeutic employment of curative serums derived from the horse. The greatest danger from this source is at the time of the first injection, for while severe effects do sometimes follow upon a second or subsequent injection, they have never been attended by fatal consequences. Luckily, means are known for anticipating these even infrequent accidents, and of guarding against their dangers without at the same time depriving those in need of the benefits of serum protection or therapy.

Beside the active state of sensitization another is known which may be termed negative. Thus it has been found that when a sensitive animal is given an injection of a protein which produces a certain degree of anaphylactic effect, but not a fatal outburst, the treated animal can for a time be rendered insensitive. And thus human beings who are sensitive, say to horse serum, may be desensitized by means of successive small inoculations of the diluted serum, and while in the refractory state thus induced receive without risk larger injections of the serum.

On the other hand, lesser states of anaphylaxis in man are by no means infrequent. To them belong the rashes of "serum sickness" following the injection of curative serums which while annoying are not dangerous, and the very disagreeable manifestations of hay fever and its allied conditions, now attributed to the action of vegetable materials, pollens chiefly, upon the sensitized mucous membranes of the nose and throat. Recent studies by Auer have shown that animals sensitized with harmless proteins, such as horse serum, develop severe local inflammations when from any local cause an extrusion of the antigen-containing fluid of the blood is enabled to penetrate the extravascular tissues; and on the basis of this observed fact he has suggested that functional disturbances of many organs of the body in sensitive human subjects may be brought about in a similar manner.

In a related field the hypersensitive reaction has been employed to aid in the diagnosis of important diseases of man and animals. It is apparent from what has been stated of the site of the fatal anaphylactic shock in the guinea pig, and as stated a moment ago of the sensitiveness of tissue cells in general to the circulating anaphylactic antigen, that a visible local reaction might be obtainable by introducing the protein to which the animal or person is sensitive into a visible portion of the body, as say the skin. In this way sensitiveness is looked for before serum injections are given, tuberculin is employed to disclose hidden foci of active tuberculosis, luetin is used to expose evidences of latent syphilis, and, in a modified manner, the Schick test is applied to determine

whether exposed children do or do not carry in their blood, spontaneously as one might say, sufficient diphtheria antitoxin to afford them security without a protective serum injection. And beside the benefits accruing to human therapy directly from the working out of the meaning of anaphylaxis are to be placed those improvements introduced into veterinary practise, from which human preventive medicine also has derived great gain, namely, the application of the tuberculin test in clearing milch herds of actively tubercular cattle, and of mallein to the controlling of glanders among horses.

FILTERABLES

As we move from the contemplation of one achievement to another in bacteriology, we rarely pause to reflect how far circumstances almost accidental have favored the gains. The working out of the biological basis of fermentation and putrefaction, and a little later of the microbic origin of disease, is obviously bound up with the perfection of the compound microscope, and the usefulness of that instrument for the purpose is as obviously bound up with the ultimate size of bacteria and related organisms. And yet without the fortunate conjunction of an optical device and the degree of magnitude of living objects, we should still be groping in outer darkness in the search for the origin of disease, and still struggling with the phantoms of spontaneous generation. But the great men who proved the connection between mieroscopic life and the biological processes mentioned, including the source of the infectious diseases, did more than describe the phenomena revealed by the microscope and otherwise. They established methods with principles so clearly enunciated and rigidly based that it has been found possible to penetrate into an inhabited territory in which thus far the most powerful microscope has not always enabled us to discern the living forms.

Thanks to their labors we know now, first, that the faculty of setting up disease in successive individuals is a property only of matter which can itself increase indefinitely, and all matter thus constituted is possessed of life; and second, that certain disease producing parasites can be separated mechanically from the soluble products of their growth, by passage through earthenware filters, in which the interstices or pores are smaller even than the size of the microbes themselves. By varying the density or porosity of these filters, we arrive at a way of roughly estimating the size of the microbic cells.

Thus it came about that in 1898 two German bacteriologists, Loeffler and Frosch, who were engaged on the study of the very highly communicable foot and mouth disease of cattle, discovered that after diluting the contents of the unbroken vesicles which arise in that disease, with 20 to 40 times their volume of water and passing them through such earthenware filters, the filtrate not only would induce the disease on inoculation, but that the same series of events followed the dilution and inoculation of the vesicular contents of the experimental variety of disease through an indefinite series. Obviously the filtrate contained a living element which came to be called a virus, just as is the smallpox germ, for in neither instance, and notwithstanding laborious endeavors, has the living organism itself ever been seen under the microscope.

We now recognize a class of microbes or viruses which are so minute as to be regarded as ultramicroscopic, and yet so active as to be capable of setting up disease in animals and man. The precise limits of the class have yet to be defined. When we consider that there remain still to be detected the microbic incitants of some of the most contagious as well as common of diseases, our minds readily seize hold of the possibility of their being of this nature. Thus the microbes responsible for such contagious maladies as measles, scarlet fever, and chicken pox, and those inducing smallpox and rabies are not known, and not a little obscurity still surrounds the etiology, as we say, or immediate origin of epidemic influenza.

Inasmuch as the filterable microorganisms or viruses, or filter passers as the British prefer to call them, are known alone through their disease-producing propensities, no one can say whether, as is true of the bacteria, in-

numerable kinds exist in nature, among which relatively a small number has acquired parasitic or pathogenic qualities. Of the less than a dozen diseases known or on good grounds considered to be induced by filterable microorganisms, two attack human beings, namely poliomyelitis or infantile paralysis, and trench fever; and a third, yellow fever, which until very recently was believed to belong also in this category, has now been relegated to another class, with respect to which special devices suffice to bring into view its microbic incitant.

There exists, therefore, a degree of uncertainty in this field of research for which allowance must be made, since it may well happen that suddenly through a fortunate series of experiments or the opening up of new methods, a parasite hitherto regarded as invisible may be brought into microscopic view. Should, for example, complete evidence be brought forward to relate the Rickettsia bodies to certain specific infectious diseases transmitted especially by insects, as by the wood tick in Rocky Mountain spotted fever, and lice in trench and typhus fevers, then another group will have been transferred from among the ultramicroscopic to the visible parasites. A similar situation exists regarding the globoid bodies of poliomyelitis, the disease of man most convincingly established as induced by a filterable microorganism. By means of a highly specialized method of cultivation applicable especially to the class of spiral microbes, or spirochetæ, Dr. Noguchi and the speaker isolated from the nervous organs of cases of poliomyelitis, globular bodies so minute as to be just at the limit of visibility under the highest power of the microscope. With cultures of these bodies they induced experimental poliomyelitis in the monkey; but the culture method itself is so intricate that thus far few bacteriologists have been able to repeat the work, which therefore still awaits final confirmation.

Since the recent pandemic of influenza and the assault made upon the so-called influenza bacillus of Pfeiffer, isolated first in Germany during the influenza epidemic of 1889–1890, the inciting microbe of that disease has been sought among the filterables. The announcement of the finding of such a parasite in the nasopharyngeal secretions by Nicolle and Lebailly of Paris in the autumn of 1918, aroused high hopes which subsequent investigations have not served to sustain. The problem was approached in a somewhat different manner by two workers—Olitsky and Gates, at the Rockefeller Institute. Their studies embraced two periods, the epidemics of 1918–1919 and 1920, and the intervening (interepidemic) period, the latter serving as a control for the former. The essence of their investigations consisted in injecting through the trachea into the lungs of rabbits saline nasopharyngeal washings derived within the first 24 to 36 hours after the appearance of symptoms from influenza patients and observing the effects (*a*) upon the blood and (*b*) upon the lungs. The striking changes, in the successful experiments, relate to the white corpuscles of the circulating blood which suffer a numerical depression affecting chiefly the mononuclear type of cells, and to the lungs in which multiple hemorrhages and edema, but not pneumonia, arise. The effects are correlated: where no lung lesions are found no blood alterations occur. These objective phenomena are induced by filtered materials free of all ordinary bacteria (ærobic and anærobic) and they have not been secured otherwise than with materials derived from early cases of epidemic influenza; but when present, the rabbits affected very readily become subject to the action of various other bacteria (streptococci, pneumococci, staphylococci, influenza bacilli), to which they are otherwise resistant, but which then settle in the lungs and excite fatal pneumonic affections. The unassisted action of the influenzal material is not fatal; only when an ordinary bacterial lung infection is superadded does death follow. All who are familiar with the effects in man of pure influenza and then of influenza complicated with pneumonia of pneumococcal, streptococcal, etc., origin will appreciate this distinction.

What also characterizes the class of diseases incited by the true filterable parasites is their

high degree of specificity and the enduring immunity which follows recovery from an attack. This is true among animals, for instance, of hog cholera and foot and mouth disease, and in man of poliomyelitis. This specificity is shown by the difficulty or impossibility of implanting the virus on specifically remote animals. In poliomyelitis, for example, only monkeys are subject to experimental infection, in hog cholera and foot and mouth disease, only swine and cattle. Bearing in mind Behring's dictum that to produce a therapeutic serum, it is essential to immunize highly susceptible animals, it becomes evident why success has not crowned the many undertakings to prepare an antipoliomyelitis serum in the horse or other large animal, and why it is only by the use of swine themselves that an anti-hog-cholera serum has been secured.

The investigation of this class of excessively minute or filterable parasites casts a sharp ray of light into a neighboring field of biological research which at the time aroused hopes of further rapid progress but which the intervening time and effort have not realized.

Perhaps no subject in experimental pathology has been pursued with more thought and energy than the one to which the name of cancer research is applied. The reasons are obvious. The nature of the source of the cancerous tumors is still shrouded in essential darkness. It is, of course, known that cancer sometimes follows upon prolonged irritation and inflammation of tissues variously excited. But what the immediate impulse is that calls forth the cancerous state is unknown. And yet advances have come from the study of the spontaneous and transplantable cancers in mice, rats and some other animals. A long series of biological conditions governing the growth and recession of the tumors have been uncovered, and by altering those conditions, on the one hand growth can be promoted, and on the other, retarded. In this way, Murphy and his coworkers have accounted for the influence of the action of the X-ray in affecting cancer growth; and by observing the correlative effects on the lymphoid structures of the body, which are very sensitive to the rays, and the changes corresponding to them in the circulating blood, they have so altered the scale as almost at will either to abolish or stiumlate the development of mouse cancers.

But these experimental results and others of a class in which the defensive forces of the body can be marshalled against the implanted cancer cells, throw no real light upon the series of events underlying the origin of cancer. The light referred to was shed by the studies of Rous, of the Rockefeller Institute, upon a sarcoma, or fleshy cancer, of the domestic fowl. This cancer, which arises at times spontaneously in fowl, is subject to successful implantation in other fowl. The specificity is accurate; it will not grow in other birds and grows best in the variety of fowl in an individual of which it originally appeared. Its growth is first local, as is cancer in man, and later metastatic, or, appearing at a distance and starting from microscopic masses of cells derived from the original tumor and carried by the circulation to remote parts of the body. The altogether new and unprecedented fact about this tumor, which has, however, not yet been found to be true of the cancers of mammals, is that it may be induced by the injection into the susceptible variety of fowls, of a cell-free filtered extract of the tumor. In other words, Rous has accomplished for this tumor what bacteriologists had effected for a certain refractory group of the infectious and communicable diseases, namely, relating it to a form of life not imagined by the founders of bacteriology, but which their discoveries in the field of the living microscopic, as opposed to the ultramicroscopic, universe brought within range of recent biological research.

SPIROCHETES

The vicissitudes of bacteriological science, like those of other sciences, have depended upon time and method, and sometimes the one and sometimes the other has served to promote discovery. When by a happy conjunction of circumstances, time and method happen to conjoin, then advances almost startling in nature may take place.

It is in this way that we may view the re-

markable progress of events in connection with a class of special microorganisms or spirochetae, so called since Schaudinn's discovery in 1905 of the *pallida*, the microbic inciter of syphilis. The search for the microbe of syphilis had been unremitting since the early days of bacteriology, and not a few false claimants held the field for a brief space. Schaudinn's discovery was very soon confirmed, and has now been firmly established; and it is interesting to note that in fact it was itself a confirmation of an observation made a few years earlier by Metchnikoff and Bordet, who, however, because of the technical difficulties of the quest did not succeed in confirming their own findings. The unusual difficulties surrounding the detection of the living *pallida* in the body fluids, because of its extreme tenuity merely heighten the respect we must hold for the zoologist Schaudinn's perspicacity. Very soon staining methods were introduced to lighten the task of detecting the *pallida*, but so capriciously did they act and so baffling did the ordinary microscopic detection prove, that the great promise of the employment of the *pallida* for purposes of diagnosis and treatment was not at once realized.

None the less, a great advance in bacteriology had been achieved, and a new class of microbes potentially disease-producing was presented for study. Within a year a second spirochete, called *pertenuis*, was discovered in the lesions of yaws, a tropical disease having certain affinities with syphilis. The search for the delicate spiral organisms was not an easy one, and only the masters of bacteriological technique were likely to succeed in it. Then suddenly the labor was lightened and the road made smooth for a rapidly succeeding succession of discoveries in this field by the invention and application of the dark-field or ultramicroscope. This instrument was perfected for observing dispersed particles in colloidal solutions and, as many of you are aware, operates by projecting powerful rays of light in directions parallel to the surface of the microscopic slide. Such a field if optically empty will be dark and not luminous; but if particles are present in it, the rays of light will be intercepted and the particles illuminated. They in turn, and according to their size, will appear as bright objects, or when very small, give a diffuse luminosity to the field. The phenomenon is similar to the one described by Tyndall, in which a beam of light passed through a dark space containing suspended particles causes them to become visible. When the suspended matter consists not only of dispersed particles, but of microorganisms, these also become luminous, and when, as with the spirochete, they exhibit a wavy structure and independent motion, they at once arrest attention. To-day the dark-field microscope is found in every well-equipped clinic, and it has aided in adding many new species to the already considerable number of microbes known to be disease-producing.

The latest significant addition to this field is the *Leptospira icteroides*, or the jaundice-producing spiral, which Noguchi has recently detected in the blood and internal organs of cases of yellow fever. His extensive investigations carried on in Ecuador, Mexico, and Peru, as well as at the Rockefeller Institute, have rendered it highly probable that this spirochete is the microbic incitant of that severe epidemic disease.

Yellow fever, as you know, is an insect-borne disease and arises from the insertion into the blood of man of a virus carried by a particular mosquito—*Stegomyia calopus*. After the mosquito transporting the virus has bitten a healthy person, an interval of about five days elapses before his blood becomes infective, and the infectiousness endures about three days longer. During the latter period the blood serum can be passed through the finest-grained porcelain filters without losing its infectivity. On the other hand, a normal mosquito which has bitten a yellow fever patient, does not become capable of infecting other human beings until after about twelve days. Hence the insect acts not merely passively, as a needle might, as the conveyer of the virus, but is necessary in order to increase

or otherwise modify the infective material withdrawn from the blood.

The discovery of the yellow fever spiral definitely removes the disease from the class believed to be provoked by ultramicroscopic organisms, and at the same time adds so well defined a microbe as *Leptospira icteroides* to the group of filter passers. The data so far secured regarding this spiral in relation to yellow fever fulfill the conditions arising out of Reed and Carroll's discoveries in connection with the disease in man. These are great gains for theoretical bacteriology. The rewards to practical medicine are even greater, since it has been found that *Leptospira icteroides* lends itself to the making of an active vaccine (killed organisms) and also an effective therapeutic serum. Hereafter yellow fever is to be combated (1) by removing the breeding places of the stegomyia, (2) through vaccination, and (3) by an antiserum.

The etiology, or causation, of yellow fever so long and fruitlessly sought seems to have been solved, and it may be of interest to inquire why just at this juncture? The answer is, through the conjunction of the "prepared mind" and animal experimentation. For nearly a decade Noguchi has been investigating this spiral class of microbes, in course of which he added materially to our knowledge of methods of study and of new species. He had first-hand knowledge of a related disease, infectious jaundice, transmissible to guinea pigs, which prevails endemically in Japan and sporadically elsewhere, and in which Inada had discovered a peculiar spiral organism (*Spirocheta icterohæmorrhagiæ*). In other words, the time was ripe and Noguchi peculiarly equipped to take up again and investigate with newer methods the problem of yellow fever.

The story is still incomplete, as recent developments have shown; for just as Metchnikoff and Bordet had seen the *pallida* before Schaudinn, so it now appears Stimson of the U. S. Public Health Service had previously observed the *icteroides*. He examined a series of sections of organs stained by Levaditi's method to show spiral organisms, taken from a patient having yellow fever who succumbed in New Orleans in 1907, and in the kidney found spiral forms to which he gave the name of *Spirocheta interrogans*, but the significance of which could not then be determined, and which Noguchi now identifies as the *icteroides*. Coming at this time and in this way, the observation is a welcome confirmation. Without the many data since supplied by Noguchi's experiments and studies of living cases of yellow fever, it possesses only suggestive value. The finding came too early in the development of our knowledge of the spirochete, and again the seed fell on stony ground.

There remains one further aspect of this incomplete discussion of spiral microbes in their relation to disease to be considered briefly, namely their separation into two classes according as the diseases induced by them respond to treatment on the one hand by curative serums, and on the other by so-called drugs or chemicals. It has just been stated that yellow fever can be combated by a serum of this kind, and the same is true of infectious jaundice. In this respect the two inciting microbes—*L. icteroides* and *S. icterohæmorrhagiæ*—behave as do certain bacteria. But the spirochete of syphilis and yaws and some others are not subject to serum influences, and hence they and the disease they induce must be attacked from another quarter, and in this instance with chemicals for which they evince an extraordinary selectiveness, as do the malarial organisms and certain parasitic trypanosomes which are of protozoal nature.

CHEMOTHERAPY

Chemotherapy is the name applied to the branch of experimental medicine in which chemicals, or drugs, are searched for, and when necesary and possible, fashioned to subdue a particular kind or class of infection. The beginnings of chemotherapy reach into the dim past; the science of chemotherapy is just being built up. The epochal discoveries of the curative value of cinchona bark in malaria and of mercury in syphilis, are examples of the early, and as we now say empirical working out of specific therapeutics.

But in emphasizing these two triumphs of the empiric period long antedating the experimental epoch in medicine, sight should not be lost of the essential point, namely that the virtues of those remedies were established also by experiment carried out over long decades and upon man himself, for in no other way could these active drugs have been separated from the thousands of innocuous or even harmful ones applied by man at all stages of his evolution to the alleviation of suffering.

In a strict sense, curative serums are examples of chemotherapy, and the most specific ones known, since they are so exactly adapted to combat a given microbe or its toxin, and because in the end the active component is chemical in character. But as usually employed, the term is applied rather to chemicals or drugs not produced by the animal body and of definite and ascertainable ultimate composition.

The beginnings of the experimental science of chemotherapy are very recent, and hardly more than a start has been made in exploring the field. The principle on which it is based can be expressed simply: microbic parasites on invading the animal body arouse defensive activities on the part of the host, which when of sufficient intensity serve to weaken and restrain, and ultimately to overthrow and conquer the invaders. These natural defenders, as we learned earlier, consist of fluid and cellular constituents of the body, sometimes preformed, sometimes only manufactured on demand, and in part especially adapted to the particular parasitic agent to be vanquished.

With this picture before them, of the manner of the body's defense against microbic invasion, bacteriologists could appreciate that the overcoming and healing of infection is never a mere passive process, and the action of healing agents in the body does not occur, as the older therapeutists believed, precisely as would happen if the parasitic agent could be exposed to the effects of drugs, say in a test tube. Moreover, it was always evident that such effective drugs as quinine and mercury must be employed sparingly, because while they were able to injure and thus to lead to the destruction of the microbes inducing malaria and syphilis, they were likewise capable of injuring the component cells of the body itself.

The outstanding instance in which experimental chemotherapy has registered a great success is in connection with the organic compounds of arsenic, which have been adapted to the overcoming of infection induced on the one hand by spirochetes and on the other by trypanosomes. That arsenical compounds possess therapeutically active properties against these two classes of parasitic diseases—as represented on the one hand by syphilis and on the other by African sleeping sickness—is not entirely a recent discovery; but until the systematic investigations of Ehrlich were instituted, which ultimately yielded salvarsan, knowledge was fragmentary, medical practise based on it ineffective, and the road to progress obscure. Now the outlook is wholly changed, and there is going forward an active and either already successful or at least highly promising search for new drugs or chemicals, directed against both the bacterial and the protozoal parasitic microbes. This territory so newly opened to exploration in which organic chemists and pathologists should pool interests in order to move forward, is of almost infinite possibility, since the number of chemicals is nearly limitless which can be produced and so fashioned as to injure and subdue as it were the parasitic invader, and at the same time, pass over and leave little influenced the adjacent body cells. But the conditions of the search are intricate since, as just indicated, a useful drug must exhibit high power of attack upon the protoplasm of a parasitic microbe and a low one on that of the cells of the blood and the organs, in order that the former and not the latter may be predominately affected. It is a peculiarity of chemicals as contrasted with serums that they can never be so accurately designed to their purposes as to remain entirely without effect on the cells of the host; but it is also recognized that when the drugs are effective, they do not carry on a single-handed combat, but serve best when they either assist or are

assisted by the natural defensive mechanisms of the body, which also are roused into action to overpower the invader and the cooperation of which often insures protection against reinvasion, acquired at the end of, and in consequence of, the struggle.

INFECTION AND SURVIVAL

Infection and the mastering of infection are intricate biological processes in which contending forces are brought into play one against the other, whence a struggle ensues. We have seen that the host stands ready equipped with mechanisms of defense which may be quickly mobilized, and which undergo favorable modification during infection, when as we say, it proceeds toward a favorable termination. The bacteriologist has learned within the past quarter of a century to imitate nature's method of surmounting infection by supplying certain of the defensive implements artificially wrought to be brought to her aid in time of stress and need, and the chemist is learning more and more the manner of adapting drugs to the destruction of the microbic parasites of disease for a like purpose.

All the advantage is, however, not on the side of the body, since the parasites also possess powers of modification, through which the most elaborate obstacles placed in their way by the host may be rendered futile.

These adaptations consist in the acquisition of special properties of aggressive action or virulence, with which is associated the ability to produce and liberate substances paralyzing to the defensive processes of the host. Again, the parasites may surround themselves with a kind of mantle, protecting them from the potentially destructive effects of serum and phagocyte. Or they may undergo an internal change of constitution, through which resistance to injurious agencies not normal to the species is developed. The last condition is called "fastness" and has been observed especially among trypanosomes and spirochetes exposed within the body of the host to ineffective amounts of specific serums or chemicals.

With so many factors interplaying, it is not difficult to perceive that the problem of infection is a complex one, both as regards its occurrence and its issue. But our understanding of the conditions under which it arises has been immeasurably extended by the discovery of the insect and higher animal agencies in communicating infective agents to man, and of the part played by so-called microbe carriers, those unfortunate and innocent persons who have recovered from or merely been exposed to a communicable disease, or suffered a slight, abortive, or ambulant attack of which they are ignorant, and the discovery of the usual portals of entry into the body of pathogenic microorganisms.

Infectious diseases prevail in two more or less distinct, but at times interwoven ways, which we speak of as the sporadic and the epidemic. The former represents the ordinary manner of spread, the latter the occasional or periodic explosive outbreak or wave, such as has been experienced recently with the pandemics of poliomyelitis, influenza and lethargic encephalitis.

What has been sought in the past and is being assiduously looked for in the present is an adequate explanation of the transition from the sporadic to the epidemic type of disease. We possess already quite accurate numerical data which show the manner in which epidemics begin, how they reach their maximum or peak, and then how they fall away again. Indeed, we now construct easily and recognize readily the epidemic curves of different epidemic diseases. But it is to be hoped that a new era is appearing in the study of epidemiology in which experiment may play a part along with observation, statistical and other. Already beginnings are being made in the attempt to define the distinction between the potentially fluctuating grades or power of infectivity and degree of virulence, taking the former to mean the natural propensity which a microbe displays in penetrating the ordinary portals leading into the body and its ability to survive and multiply there, and the latter the capacity to overcome the natural defenses when artificially inoculated. This is a field clearly approachable by experiment, using

small laboratory animals, among which arise from time to time, and much as happens with man himself, destructive epidemics induced by known microbes. Finally, there is the field in which not a single species of microbe is concerned but more than one, the first preparing, the other utilizing the prepared way for its more vicious purposes. Frequent examples of the last condition are observed among the lower animals, in which, of course, the opportunities for study are superior to those existing in man; but recent experiences in this and other countries during the influenza epidemic carry conviction of this relationship, since the original disease is recognized to be not of severe nature, while the pneumonia engrafted upon it is admittedly of highly fatal character.

My purpose in reviewing some of the notable events and tendencies in bacteriology which have come to light in the past twenty-five years has been to present to your consideration the achievements in one branch of modern medicine, and to indicate the relation subsisting between medicine and the more fundamental sciences of physics, chemistry and biology. Bacteriology has depended also for its development on its sister sciences of physiology, pharmacology and pathology, without which many of its phenomena could not be interpreted. It seems but proper to state that what has been attempted here for bacteriology could readily be equalled or even exceeded by spokesmen for those sister sciences, so surely has medicine grown scientific in recent times.

SIMON FLEXNER

SCIENTIFIC EVENTS

MUSEUM OF THE BUFFALO SOCIETY OF NATURAL SCIENCES[1]

ON October 16 the Buffalo Society of Natural Sciences opened its New Museum at 1231 Elmwood Avenue. This building is merely the inner court of a much larger museum which is to be erected by the society as soon as funds are available. The court measures approximately a fifty-five foot square. There is also a lobby, hall and office on the main floor and an office and two work shops on the second floor.

The entire idea of the New Museum exhibit is to give every man, woman and child who visits it the opportunity to understand the evolution of this earth from the time it was a part of a nebula arm up to the present decade. The hall of the building is devoted to astronomy and meteorology, many of the transparencies having just been obtained from the Mount Wilson and Yerkes Observatories.

The next exhibit is dynamical in nature, telling of what elements our earth is made and of the forces that have changed the earth's crust to form continents, oceans, rivers, lakes and mountains.

This is followed by an exhibit of paleontology which touches on the flora and fauna of the sixteen great geologic ages and ends with an evolutionary exhibit of man and one of the horse.

The last exhibit exemplifies the way in which man has utilized nature's products. It is truly marvelous how dyes have been made from coal tar; silk garments, alcohol, linoleum, tar and paper from wood; and the beautiful Deldare semi-porcelain ware from the commonest clay.

Among other interesting objects to be found in the museum are the relief maps of such localities as Mount Shasta, Mount Vesuvius, and the Grand Canyon of the Colorado. There is a very large relief map of Erie County which occupies a large space in the center of the floor. It was constructed by Frederick Burgie, of Rochester.

Two cases have been reserved as a display ground for especially beautiful objects owned by the society. At present these cases are filled with precious and semi-precious stones, many of them in the matrix.

Of especial interest to the children is the fine exhibit of birds and animals which have been mounted by Joseph Santens. Mr. Santens is at present completing a collection of native birds which will be studied by the school children under the new Nature Study Syllabus as published by the regents of the state of New York.

[1] From *The Museums Journal.*

MEDALS OF THE ROYAL SOCIETY

At the anniversary meeting of the Royal Society on November 30 the medals were awarded in accordance with the announcement already made. The citations of several of the medalists were as follows:

The Rumford medal is awarded to Lord Rayleigh, who is distinguished for his researches into the properties of gases at high vacua, and whose work has opened the way to many valuable investigations. Some years ago Lord Rayleigh made a number of interesting observations on the afterglow in various gases noticeable after the cessation of an electric discharge, and these led in 1911 to his Bakerian lecture on "The Afterglow of Nitrogen." The investigation thus started has proved the subject of much of his recent work, and in a series of most valuable papers he has studied the properties of the gas in which this afterglow is visible.

A Royal medal is awarded to Dr. William Bateson, who is universally recognized as a leading authority on genetics, and has done more than anyone else to put that branch of inquiry on a scientific basis. The work that stands to his name is, however, but a fraction of that which he has inspired wherever biological research is prosecuted. In conjunction with Professor Punnett he worked out in detail one of the earliest cases of sex-linked inheritance. Peculiar association of genetic factors in gameto-genesis had previously been discovered by the same authors and described under the terms "coupling" and "repulsion." In 1911 they published two papers which proved that these phenomena are part of a more general phenomenon of linkage, the orderly nature of which was pointed out. Since these papers appeared the phenomenon has been shown by various workers to be widespread in both animals and plants. Three papers by Bateson and C. Pellew record a discovery of high interest and importance, viz., that the germ-cells of the same plant may vary in their genetic properties. It is further pointed out that the variation proceeds in an orderly way from the base of the plant to the apex. The conception is a novel one, and is bound to have great influence on the development of genetical theory.

The Darwin medal is awarded to Professor Roland Harry Biffen, who has worked out the inheritance of practically all the obvious characters of wheat and barley. Perhaps his best-known work is that on the inheritance of strength in wheat and on the inheritance of susceptibility and resistance to yellow rust in wheat. Biffen's activity is not by any means to be measured by his published work. Two of his new wheats—Little Joss, which owes its value to its immunity from rust, and Yeoman, which combines high yield with first-class baking quality—are among the most popular wheats in the country, and together account for something like a third, or even a half, of the wheat crop of England.

The Hughes medal is awarded to Professor Owen Williams Richardson for his researches on the passage of electricity through gases, and especially for those relating to the emission of electrons from hot bodies—a subject which Professor Richardson has made his own and christened "thermionics." The subject is of great industrial as well as of scientific importance.

THE PHILADELPHIA ACADEMY OF NATURAL SCIENCES

At the annual meeting of The Academy of Natural Sciences of Philadelphia, held December 21, 1920, the following officers, councillors and members of the committee on accounts were elected to serve during 1921.

President: John Cadwalader, LL.D.

Vice-Presidents: Edwin G. Conklin, Ph.D.; Henry Skinner, M.D.

Recording Secretary: James A. G. Rehn.

Corresponding Secretary: J. Percy Moore, Ph.D.

Treasurer: George Vaux, Jr.

Librarian: Edward J. Nolan, M.D.

Curators: Witmer Stone, A.M., Sc.D.; Henry A. Pilsbry, Sc.D.; Henry Tucker, M.D.; Spencer Trotter, M.D.

Councillors to Serve Three Years: Charles B. Penrose, M.D.; Charles Morris; William E. Hughes, M.D.; Roswell C. Williams, Jr.

Councillor to Fill an Unexpired Term—1921 to 1922: Milton J. Greenman, M.D.

Committee on Accounts: Charles Morris; Samuel N. Rhodes; John G. Rothermel; Thomas S. Stewart, M.D.; Walter Horstmann.

At the meeting of the academy held November 16, 1920, the following was adopted:

Resolved: That in recognition of the exceptionally long period (covering 58 years) of his service to the academy, of his undeviating loyalty to its interests, and of the geniality of manner that endeared him to members and visitors alike, Dr. Edward J. Nolan be, upon the election of his suc-

cessor, given the honorary title for life of recording secretary emeritus, and that he be so designated in all official lists of the officers of the academy.

THE NEW YORK ACADEMY OF SCIENCES

THE annual meeting of the academy for the election of officers, fellows and honorary members, the presentation of reports and the transaction of other business was held at the Delta Kappa Epsilon Club, 30 West 44th Street, on the evening of Monday, December 20.

The report of the corresponding secretary showed that there are now upon the rolls of the Academy 31 Honorary Members and 102 Corresponding Members. The death of the following Honorary and Corresponding Members was recorded with regret:

Sir Norman Lockyer, honorary member since 1880.
Professor Wilhelm Pfeffer, honorary member since 1898.
Professor Wilhelm Wundt, honorary member since 1904.
Professor George Macloskie, corresponding member since 1876.
Professor Joseph Paxon Iddings, corresponding member since 1896.

There have been held during the year 7 business meetings and 26 sectional meetings at which 40 stated papers were presented. The membership of the academy is 575, which includes 415 active members, 24 associate members, 109 life members, 8 patrons, 1 benefactor and 18 non-resident members, of whom 148 are fellows.

Record was made of the loss by death of 15 members.

The treasurer reported that the receipts for the fiscal year were $7,962.86, and the expenditures were $7,386.98. The investments of the academy amount to $53,198.88, held to cover the various funds. The details of the treasurer's report will be published in the *Annals*.

The academy elected Baron Gerard De Geer of Stockholm, Sweden, an Honorary Member. Fifteen members of the academy were elected to fellowship.

The following officers for 1921 were elected:

President: Edward L. Thorndike.
Vice-Presidents: William J. Gies, Charles L. Bristol, James F. Kemp, Robert S. Woodworth.
Recording Secretary: Ralph W. Tower.
Corresponding Secretary: Henry E. Crampton.
Treasurer: John Tatlock.

SCIENTIFIC NOTES AND NEWS

THERE is printed in the present issue of SCIENCE the presidential address before the American Association for the Advancement of Science given this week by Dr. Simon Flexner. We hope to print next week an account of the meeting and that the succeeding issues of SCIENCE will contain the official addresses given at Chicago and accounts of the meetings of the sections and of the affiliated societies.

DR. WILLIAM W. COBLENTZ, of the Bureau of Standards, has been awarded the Janssen Medal of the Paris Academy of Sciences for his work on measuring the heat of the stars.

DURING the past month Dr. Franz Boas, professor of anthropology at Columbia University, has been elected an honorary member of the Société des Amèricanistes of Paris and of the Folklore Society of London. He has also been elected corresponding member of the Prussian Academy of Sciences, Berlin, and has received the gold medal of the Anthropological Society of Berlin.

DR. RALPH S. LILLIE has resigned the professorship of biology at Clark University to accept the position of biologist, department of pure science, Nela Research Laboratories, National Lamp Works of the General Electric Company, Nela Park, Cleveland, Ohio. Dr. Lillie will retain his connection with the Marine Biological Laboratory, Woods Hole, and will carry on his work there in the summers as usual.

PAUL M. REA, president of The American Association of Museums, who has now become director of the new Cleveland Museum of Natural History, will be succeeded by Miss Laura M. Bragg in the directorship of The Charleston Museum, South Carolina.

DR. FRANK H. REITER, instructor in psychology at the University of Pennsylvania for the past six years, has resigned his position to become psychologist in the public school system of Newark, New Jersey, where he will succeed Dr. Francis N. Maxfield, recently appointed director of psychology in the Pennsylvania State Department of Education.

DR. WELLINGTON D. JONES, assistant professor of geography and dean in the college of science at the University of Chicago, recently sailed for England on his way to India, where he expects to make geographical studies.

DR. ALEŠ HRDLIČKA has been named doctor *honoris causa* of the University of Prague.

PROFESSOR J. PERRIN (Paris) and Professor C. Fabry (Marseilles) have been elected honorary members of the Royal Institution, London.

DR. JOHN G. COULTER, who was in charge of the agricultural operations of the American Expeditionary Forces, and, after the armistice, Commandant of the Detachment for Agricultural Education, is now at Chateau Sandricourt, Meru, Oise, as manager of certain American-owned agricultural properties. He is collecting material concerning science teaching in France and would be glad to be of service to American enquirers for French educational data.

DR. RALPH E. HALL, formerly of the Geophysical Laboratory of the Carnegie Institution of Washington, has resigned from the Firestone Rubber Company, of Akron, Ohio, to accept a position with the Koppers Company, manufacturers of by-product coke ovens, at Pittsburgh, Pennsylvania.

F. L. RANSOME, of the U. S. Geological Survey, has left Washington for field work in Arizona.

YALE UNIVERSITY has received a letter from Charles Edward Adams, the head of the Hector Observatory at Wellington, New Zealand, accepting the appointment of associate in astronomy. Dr. Adams, who is the government astronomer and seismologist of New Zealand, has agreed to cooperate with the Yale Observatory in connection with photographing the stars of the southern hemisphere for compiling zone catalogues.

A JAPANESE translation of "The Subconscious," a textbook by Professor Joseph Jastrow, of the department of psychology of the University of Wisconsin, is to be published in the near future. The translation is being made under the direction of Dr. Nakamura, Japanese psychologist and editor of the Japanese *Journal of Abnormal Psychology*. The book was translated into French shortly after its appearance. A German translation was arranged for before the war but this undertaking has not been completed.

THE staff of the Lowell Observatory at Flagstaff, Arizona, at the request of Mrs. Lowell, widow of the late Dr. Percival Lowell, is giving a series of six lectures called "The Lowell Popular Lectures in Astronomy" in the large auditorium of the Northern Arizona Normal School. These lectures are free to the students of the school and to the townspeople in general. Dr. Hamilton gave the first lecture, "The Solar System," on December 14. The next lecture of the series will be given on January 5 by Mr. Truman on the subject "Curiosities among the Stars."

THE lectures for 1920–21 on the Silliman Foundation at Yale University were delivered by Professor Leo F. Rettger, on December 13 and 15. The subject was "Some problems of intestinal bacteriology."

DR. HIDEYO NOGUCHI, of the Rockefeller Institute for Medical Research, New York City, gave a lecture at the National Museum on November 17, on "Recent studies of yellow fever." The lecture was given under the auspices of the Army Medical School.

DR. L. EMMETT HOLT, of Columbia University, New York City, has been appointed Lane Medical Lecturer for the year 1921 at the Medical School of Stanford University, San Francisco, California. The lectures will be delivered in the week beginning on November 28, 1921, and the general subject will be "Growth and Nutrition."

Sir William Abney, distinguished for his contributions to photography and color vision, died on December 2 at the age of seventy-seven years.

The death is also announced of Dr. G. von Bunge, professor of physiology at the University of Basel, aged seventy-six years.

Dr. Karl Toldt, professor emeritus of anatomy at the University of Vienna, author of numerous publications on the development of the gastric and other glands and the embryology of the genital organs and on comparative anthropology, has died at the age of eighty years.

The Robert Koch Foundation for Combating Tuberculosis has awarded the prize of 5,000 Marks for the best work on the subject "The Value of the Various Kinds of Rays (Sun, Roentgen, Radium, Mesothorium) for the Diagnosis and Treatment of Tuberculosis" to Dr. Gassul, a former assistant in the Berlin University Institute for the Investigation of Cancer.

A formal resolution thanking Thomas E. Brittingham, of Madison, for the bronze bust of the late President Charles R. Van Hise, which he recently presented to the University of Wisconsin, has been voted by the Regents of the University. The resolution is as follows:

Resolved: That the Regents accept with their warmest thanks the "Pietro bust" of President Van Hise as a gift from the Honorable T. E. Brittingham. They recognize in this gift a continuation of that generosity which has already brought to the University the Lincoln statue and the Muir bust. Like these predecessors, this bust is a permanent possession for the University, of great historic interest and artistic excellence. It brings with it also those feelings which come with the likeness of a distinguished leader and beloved comrade whose recent loss is a fresh grief both to the regents and to the donor.

A meeting of the committee formed to establish a memorial to the late Sir Victor Horsley was held at the house of the Royal Society of Medicine on November 3; an executive committee was appointed to take steps to raise a fund, of which the senate of the University of London would be trustees, for the endowment of a lectureship or scholarship to perpetuate the memory of Sir Victor Horsley's scientific and public work.

UNIVERSITY AND EDUCATIONAL NEWS

Plans have been completed by the trustees of the Johns Hopkins Hospital for the reconstruction of the hospital group, which will involve an investment of approximately $11,500,000, including $6,750,000 as a permanent endowment fund. The first unit will be started next summer by the erection of a new pathologic building, costing $600,000, to replace the structure destroyed by fire last winter.

It is planned to establish a technical school at Oberlin College with accommodations for about 700 students.

The University of Liverpool has instituted a diploma in medical radiology and electrology. A course of post-graduate work extending over six months is required before a candidate can enter for the examination. Instruction in physics constitutes part of the course. Mr. C. Thurstan Holland has been appointed a university lecturer in charge of the department of radiology.

Dr. John Auer, of the Rockefeller Institute for Medical Research, has accepted the headship of the newly established department of pharmacology in the St. Louis University School of Medicine. The appointment of other members of the staff of this department will be announced later.

George Reber Wieland, Ph.D., lecturer of paleobotany in Yale University, has been appointed a research assistant in paleobotany with the rank of assistant professor.

Dr. Samuel W. Fernberger, assistant professor of psychology at Clark University, has become assistant professor of psychology in the University of Pennsylvania.

Dr. C. L. Turner, of Wooster College, has succeeded Dr. T. W. Galloway as professor of zoology at Beloit College.

DISCUSSION AND CORRESPONDENCE

HIGH TEMPERATURES AND EMISSION FROM GASES

IN view of the discussion between Dr. A. S. King[1] and Dr. G. A. Hemsalech[2] upon the origin of the spectra obtained in the carbon tube furnace, it may be of interest to call attention to the complete absence of emission lines in mercury vapor, argon, nitrogen and hydrogen, when heated to 3200° K. by means of a tungsten filament.

Observations of the heated zone adjacent to the filament while shielding the spectroscope slit from the filament radiation have shown no evidence of emission in the visible region from any of the above gases.

Professor F. A. Saunders was kind enough to photograph the spectrum from a tungsten spiral at 3200° K. operating in mercury vapor at approximately atmospheric pressure in a quartz bulb. He obtained no trace of emission lines, but did find an absorption at λ 2536.

The potential gradient along the wires varied from about 1.5 volt per centimeter in mercury vapor to 15 volts cm. in hydrogen.

These results suggest that the spectra obtained in the carbon tube furnace are neither primarily dependent upon potential gradient nor temperature, but are probably more of the nature of flame spectra produced by chemical reactions between the various elements present in the tube.

G. M. J. MACKAY

RESEARCH LABORATORY,
GENERAL ELECTRIC CO.,
SCHENECTADY, N. Y.

A POSSIBLE RELATION BETWEEN MECHANICAL, ELECTRICAL AND CHEMICAL QUANTITIES

TO THE EDITOR OF SCIENCE: In my note in your issue of November 26, page 509, on "A possible relation between mechanical, electrical and chemical quantities" (?), I regret that by an oversight I omitted to add that this relation applies to a valence of unity, as it is in the case of silver, which element was used in deducing it. For any other valence the atomic weight must of course be divided by that particular valence.

CARL HERING

PHILADELPHIA,
December 2, 1920

REQUEST FOR SEPARATES

IN a note from Professor A. Dehorne, of the Institute de Zoologie, Université de Lille, France, it is stated that the straitened financial circumstances of the university library at Lille permit the purchase of but few biological publications, *La Cellule*, for example, being the only cytological journal received. In accordance with Professor Dehorne's request, may I urge cytologists and other workers in biology to send him separates of their published articles, and thus contribute to the development of biology at Lille. Such contributions can easily be made, and they will surely be appreciated very highly.

LESTER W. SHARP

AN APPEAL FOR PUBLICATIONS FOR CZECHOSLOVAKIA

WITHIN the two brief years of its existence the new Czechoslovak Republic has established two new universities—one at Brno (Brünn) and the other at Bratislava (Pressburg), besides a series of high schools and several thousands of common schools. In addition, the University of Prague finds itself this year with a nearly redoubled number of students, of whom there are now over 10,000. With the generally and greatly reduced exchange value of European currency, it has become exceedingly difficult for the scientific men of these universities to provide themselves with literature published since 1914, and they appeal to their American colleagues for help in this direction. The publications needed are those reporting original research in all branches of science. Sets of reprints of individual investigators, and periodicals, will be particularly valued. Besides these, however, any reprints or scientifically valuable volumes that

[1] *Astrophys. Journal*, 52, 187, October, 1920.

[2] *Phil. Mag.*, 36, 209, 281, 1920; 39, 241, 1920.

can be spared will be welcome, even though they may be of the older dates. The publications should be sent to the Czechoslovak Legation, 1732 N St. N.W., Washington, D. C., from where they will be forwarded to the men and institutions most in need of them through the International Exchange Bureau of the Smithsonian Institution; or they may be sent or delivered to the writer.

A. Hrdlička

U. S. National Museum,
Washington, D. C.

NOTES ON METEOROLOGY AND CLIMATOLOGY

HURRICANES

We have been told by those who have visited the West Indies, that the natives have named the hurricane warning flag, which is displayed by the Weather Bureau, "*el panuelo del Diablo*," or the devil's handkerchief. Such a name conveys a fair impression of the natives' opinion of the hurricane. We are also told that the various hurricanes are named after saints of the church, and birth-dates, marriage-dates, and death-dates, are reckoned from them. In other words, the hurricane is decidedly an *event* in the lives of those who experienced it. But the native West Indian is not the only one who has a respectful regard for the hurricane, for the vessel masters, whose ships ply the Gulf of Mexico, and those residents of the United States who inhabit the cities along the Gulf Coast have learned by sad experience to betake themselves to places of safety upon the approach of these interesting and destructive storms.

The West Indian hurricane, or tropical cyclone, is an area of low barometric pressure; but it differs in several respects from the extratropical lows which cross the United States from west to east in unending procession. The isobars of the tropical cyclone are circular and the distribution of meteorological elements about the storm center is symmetrical, whereas the extratropical low usually is elliptical in form and displays a marked lack of symmetry in the distribution of temperature, precipitation and cloudiness. The tropical storm which affects the West Indies and the United States, usually has its origin in the doldrums, or low-pressure calms which in mild-, and late-, summer lie along latitude about 10° N., in the region of the Caribbean Sea and eastward. Its course is first toward the northwest, or west-northwest, and later, usually in about latitude 30° N., curves northward and finally northeast. After entering the mainland the effect of the storm is soon lost; and, while it may be very destructive in the immediate vicinity of the coast, its further progress is characterized by a diminution of intensity and an acquisition of the characteristics of the extratropical low.

One of the most troublesome features of the hurricane, from the meteorologist's point of view, is that the main part of its course lies over water, and, since ships make every effort to escape the storm, the forecaster is left in utter darkness as to the exact location of the disturbance and its direction of movement. When a warning is once given of the presence of such a storm in the Gulf, all vessels in port refrain from sailing until the danger is passed. While this is decidedly profitable for the vessels, it makes the meteorologist the victim of his own efficiency, for it deprives him of observations of clouds, pressure, etc., which are so valuable to him in forecasting the part of the coast where the hurricane is most likely to strike. For this reason, it is necessary to utilize whatever observational data can be obtained along the coast, and Dr. Cline, of the New Orleans office of the Weather Bureau, has recently published a paper[1] in which he states his belief that the tides are a reliable criterion of the direction of motion of the hurricane while a considerable distance at sea.

Dr. Cline, after a brief mention of the wave-producing powers of winds, takes up all the hurricanes which occurred between 1900 and 1919. In their chronological order, he

[1] Cline, Isaac M., "Relation of Changes in Storm Tides on the Coast of the Gulf of Mexico to the Center and Movement of Hurricanes," *Monthly Weather Review*, March, 1920, pp. 127–146.

points out the relations existing between the tides at various Gulf stations and the position of the hurricanes in the Gulf. He is enabled by these studies to show the portion of the storm in which the greatet wave-producing winds occur. The quotation from John Eliot's "Cyclonic Storms in the Bay of Bengal" regarding the wave-producing power of the hurricanes is worth repeating here:

Whatever explanation be adopted of the production of these large waves, there is no doubt of the general principle that air moving over a water surface always produces waves, and that the magnitude of the waves is dependent upon the extent of the water area over which they blow and upon the force of the winds. It is evident that the strength of the swell or the distance at which it will be sensibly felt in the open sea, will depend partly upon the strength of the producing winds and partly upon the distance over which the producing winds act with no considerable change in direction. The rapid movement of the air over the surface of the sea gives rise, by some species of cumulative action to a continuous succession of large parallel waves so long as the winds are fairly steady in character. Waves that are produced in this manner travel steadily onward in the same general direction so long as they meet no obstruction, and if they pass beyond the area of strong winds, they decrease slowly in height and force.

It was noted by Mr. Eliot that in the Bay of Bengal the swells were observed 400 miles from the center of the storm and forty-eight hours before its arrival.

Dr. Cline has given a diagram of the type of waves and swells which emanate from a hurricane, and he finds that the greatest waves are produced in the rear right-hand quadrant of the storm and travel forward through the storm and make themselves felt far in front and mostly to the right side of the line of advance at the time the wave left the storm. These waves travel in the direction of the storm's motion. Waves of lesser amplitude are sent out to the right and left of the center of advance of the storm in the front half, still smaller, weaker waves are sent out to right and left in the rear of the storm; and finally, the weakest waves of all are sent out in the rear.

How intense the winds are in the rear right-hand quadrant of the advancing hurrricane may be seen from the following (indicated) wind velocities observed at Burrwood, La., near the mouth of the Mississippi River, upon the occasion of the hurricane of September 29, 1915:

Sixty miles per hour or above prevailed for a period of 13 hours.

Seventy miles per hour or above prevailed for a period of 12 hours.

Eighty miles per hour or above prevailed for a period of 11 hours.

Ninety miles per hour or above prevailed for a period of 3 hours.

One hundred and eight miles per hour prevailed for a period of 2 hours.

One hundred and sixteen miles per hour prevailed for one third of an hour.

There was a gust with 1 mile at the rate of 140 miles per hour.

It appears that as these waves begin to reach the coast there is a piling up of water, which is, of course, in excess of the normal predicted tide. By carefully noting and comparing the high water at various stations it is possible, Dr. Cline believes, to detect changes in direction of movement of the disturbance. As an example of this, and also of the fact that the rise of water precedes any change in the barometer, he cites the case of the storm of September 11–14, 1919, in which the "barometer at Burrwood, New Orleans, Galveston and Corpus Christi was either stationary or falling only a few hundredths of an inch, the water, first at Burrwood, later at Galveston, and then at Aransas Pass was rising in feet, telling the story of the movement and of the change in the course of the storm as plainly as could be told."

By this method it is possible to tell whether the storm is shifting its course to right or left by the shifting of the point of greatest rise to right or left. The regular tides are not obscured by these storm tides except perhaps in the last twelve hours before the storm strikes, when there are other features of prognostic value which can be relied upon. The

highest water occurs a few miles to the right and at about the time of passage of the center and high water is observed from 100 to 200 miles to the right of the storm, while to the left it is hardly observed at all.

An interesting point is the effect upon the height of the water which may be attributed to the decreased atmospheric pressure in the center of the storm. This of course will allow the water to be raised in that vicinity. In the great hurricane of 1900, which passed inland at Galveston the pressure was low enough to have caused a rise of 1.5 feet in the level of the water. There is no danger of confusing such an effect as this, however, with the main storm-tide, because the amplitude of the storm-tide is much greater; indeed, in this case, it was 15 feet.

The apparent simplicity of this method of forecasting hurricanes must not be overestimated, however. The hurricane is a capricious disturbance and difficulties may be introduced by its unusual conduct either with respect to its rate of movement, or point of recurving. An example of this may be made in the hurricane of September 21–22, 1920.[2] This storm, as indicated by the tides after it entered the Gulf, was moving in the direction of the coast between Corpus Christi and Galveston; but it recurved and with unexpected speed swept northward and inland near Morgan City, La. The difficulty was that, owing to the unexpected late recurving and unusual speed, it was impossible to forecast the actual point of entrance. As a consequence, the warnings were displayed first from Corpus Christi to Port Arthur, Texas, and then extended to include the coast as far east as Pensacola. In retrospect, it is seen that the method worked out well enough; but the peculiarities of the storm's movement preclude a satisfactory application of the method. In this case, the method did not give as great precision as might be required; but it must not be inferred that the method is faulty. Anything that will improve the forecasting of hurricanes is welcomed, and it can not be said that Dr. Cline's paper does not constitute a genuine contribution to this difficult and troublesome question.

[2] *Cf.* Cline, Isaac M., "The Life History of Tropical Storm in Louisiana, September 21 and 22, 1920," *Monthly Weather Review*, September, 1920, pp. 520–524.

C. LeRoy Meisinger
Washington, D. C.

SPECIAL ARTICLES

THE COLLECTION OF RADIUM EMANATION FOR THERAPEUTIC USE[1]

The practise of using radium emanation instead of radium salts for therapeutic purposes is now thoroughly established in this country. Its advantages are so patent that all of the hospitals and clinics, where large quantities of radium are employed, have had their radium salts converted to soluble form, and collect emanation from solution.

It is necessary, however, to separate the emanation from hydrogen, oxygen and other gases which accompany it in the collection, in order to reduce its volume to meet the requirements. This can be accomplished by several different methods: (1) The chemical method of purification by heating copper oxide and other chemicals in a tube through which the gases pass before being confined in small volume over mercury; (2) the method of Professor Duane[2] of passing the gases over an electrically heated partially oxidized copper wire; (3) the method of freezing emanation at liquid air temperature and pumping off the residual gases. This method may also be employed in conjunction with either of the first two.

All three methods require a rather complicated apparatus and manipulations which can be carried out only by a specialist. It occurred to the writer that some simplification might be introduced by collecting emanation from the highly heated or fused radium salts, thus avoiding the presence of water and the consequent large volume of hydrogen and oxygen resulting from its decomposition. It

[1] Published with permission of the director of the United States Bureau of Mines.

[2] *Phys. Rev.* (2), 5, 311, 1915.

is probable that the gas collected from the fusion or high-temperature treatment would require no further purification for therapeutic use.

The liberation of small quantities of emanation by high temperatures has already been successfully applied in the quantitative measurement of radium by the emanation method. There is nothing novel in the idea, and its application has already been tested out under somewhat different conditions. The object of the present note is simply to call attemtion to the possibility of applying the same principle to the collection of large quantities of emanation for therapeutic use, and to leave the field open for experimentation by the different laboratories and companies interested.

The procedure might be varied in several ways. Fusion might be employed with or without a flux; possibly temperatures considerably below fusion will be found to liberate emanation from some salts with a satisfactory recovery. The salts come mainly in consideration are: The chloride, bromide, carbonate and sulfate. With the chloride or bromide the corresponding lithium salt might prove to be a good flux. Experiments with other salts of radium might disclose one that would yield its emanation at a still lower temperature.

It should also be investigated whether the state of fusion per se is favorable to the liberation of emanation. It is possible that a viscous fusion just above its melting-point would not liberate emanation so readily as the more porus salt before fusion. The effect of various proportions of barium should also be studied, as well as volatilization losses under various conditions with different salts.

The heating should preferably be electrical, but whether internally or externaly applied is a matter for determination.

The collection after liberation might be by means of mercury displacement or by liquid air condensation.

S. C. LIND

GOLDEN, COLORADO,
November, 1920

A QUANTITATIVE SURVEY OF THE FLORA OF LAKE MENDOTA

IN the summer of 1919, quantitative determinations were undertaken for the Wisconsin Geological and Natural History Survey, of the submerged vegetation of Lake Mendota, Madison, Wis. The object of the work was to form an estimate of the total amounts of the various species present in the lake, and to obtain such additional data as might be available on their comparative distribution.

The plants were gathered by hand from measured areas of the lake bottom. For this purpose the whole plant zone of the lake was divided into stations according to local differences in physical and floral characteristics. Samples were gathered at different depths in each station. The plant zone is continuous around the lake in water not deeper than 7 m. The samples thus gathered were separated into their component species, and their wet and dry weights determined.

For purposes of calculation the plant zone was divided into three depth-zones, namely, 0 to 1 m., 1 m. to 3 m., 3 m. to 7 m., this arbitrary classification being based on evident differences in the character of the vegetation at different depths. By averaging the weights of the various samples gathered within one depth-zone, and comparing this average with the total area of that zone, as measured on a map, the total weight of each species in each zone was computed, and by addition the total weights for the whole plant zone.

The total amount of plants collected in this way was some 93 kilograms wet, 11 kilograms dry, the average water content being about 88 per cent. This material was obtained in 221 samples taken from 35 stations. The yield of the entire lake, estimated on the basis of these collections, is in round numbers 18,500,000 kilograms wet, 2,100,000 kilograms dry. The total area of the plant zone is 10,040,000 square meters. The yield per unit area is therefore 18,426 kilograms per hectare wet, 2,091 kiligrams per hectare dry (or 16,215 pounds per acre wet, 1,840 pounds per acre dry).

Almost one half of the total yield is found in water from 1 m. to 3 m. in depth. More than one quarter is found in water shallower than this, and a quarter in deeper water (3 m. to 7 m.).

Almost one half of the wet weight of the total yield is made up of *Vallisneria spiralis*. The dry weight of this plant forms a somewhat smaller fraction of the whole, owing to its relatively high water content. The remainder of the vegetation is composed mainly of various species of *Potamogeton*. *P. amplifolius* composes about one quarter of the total, *P. pectinatus* and *P. Richardsonii* each about one tenth. None of the remaining species exceeds 4 per cent. of the total.

The above is an average for the whole plant zone. At different depths the situation varies. *Potamogeton pectinatus*, *P. Richardsonii*, and other species, including *Najas flexilis*, *Ranunculus aquatilis*, and *Chara crispa*, bulk large in water less than 1 m. in depth. Between the depths of 1 m. and 3 m., *Potamogeton amplifolius* replaces to a large extent the other species of this genus, and *Myriophyllum* and *Ceratophyllum* are abundant. In the deepest water (3 m. to 7 m.), *P. amplifolius* composes about one half of the entire vegetation. *Vallisneria* forms a large part of the growth at all depths.

The greater the depth, the smaller is the number of species. Many plants are restricted to the shallow water. Among these are *Ranunculus* and the rare species *Potamogeton lucens*. On the other hand, most of the *Potamogeton zosterifolius* is found in water deeper than 3 m., and about three quarters of the *Myriophyllum* and *Ceratophyllum* is found in water from 1 m. to 3 m.

Within each depth-zone, the abundance of the vegetation is different in different stations. The figures obtained represent, therefore, averages of widely varying conditions. Much of this difference is correlated with the character of the lake bottom. Especially in the shallowest water, there are large tracts of sandy bottom, on which *Potamogeton pectinatus*, *P. Richardsonii*, *Ranunculus*, *Najas*, and *Chara* thrive, while other species do better in muddy regions. *Vallisneria* flourishes equally on mud or on sand. Both the character of the bottom and the nature of the flora are more uniform in the deeper water.

In addition to the plant zone as a whole, there are a large number of shallow bays which have distinctive flora. Here grow a number of marsh and pond plants not found elsewhere in the lake, including *Scirpus lacustris*, *Castalia odorata*, *Nymphaea advena*, *Typha latifolia*, and other less common species Almost all the other species found in the lake are also present in the shallow bays. Here also the character of the vegetation varies considerably with the nature of the bottom. Quantitative determinations of this class of cases were very difficult to make, owing to the irregular, patchy nature of the growth, especially in the case of the larger marsh plants.

Around the margin of the lake extends a narrow strip of *Cladophora glomerata*, growing attached to rocks of various sizes. This plant varies greatly at different points in the density of its growth. Samples were collected from representative spots, field notes taken on the general distribution and abundance of the species, and an estimate of the total made on the basis of these data.

A detailed report of these investigations is to be published in the *Transactions* of the Wisconsin Academy of Sciences, Arts, and Letters.

H. W. Rickett

Department of Botany,
University of Wisconsin

THE AMERICAN CHEMICAL SOCIETY

(*Continued*)

DIVISION OF DYE CHEMISTRY

A. B. Davis, *chairman*.

R. Norris Shreve, *secretary*.

Wednesday and Thursday

Physiology Lecture Room

New naphthalene dyes: A. S. Wheeler. The tones produced vary with the reaction of the bath and also may be modified considerably by the use of mordants. The sulfonation of napthalene with fuming sulphuric acid, is carried out at a low temperature and is so regulated that the

naphthalene 1, 5-disulfonic acid is obtained. This is fused with caustic soda and the resulting naphthol is oxidized with chromic acid to juglone. This hydroxynaphthoquinone yields a wide variety of halogen derivatives; additional products at low temperatures, and substitution products at high temperature. These are dyes since they contain both the chromophore and auxochrome groups. Both chlorine and bromine derivatives of juglone have been prepared. Tribromojuglone is obtained in yields of nearly 100 per cent. of the theoretical, is rich red in color while its sodium salt is indigo blue. The new work in this field includes the preparation of some ethers. Methyl ether, brick red crystals, its sodium salt being difficult to prepare; ethyl ether, yellowish red needles, its sodium salt being readily made. The influence of the alkyl radicles is to cause the dyes to become reddish in tone.

Applications of maleic and fumaric acids and their salts in the textile industry: J. H. Carpenter. This paper gives a brief outline of the excellent results obtained with the use of maleic and fumaric acids when used as mordanting assistants in the chroming of wool, and briefly points out the real commercial possibilities for these acids. The subject of their use in the scrooping and dyeing of silk is taken up and some positive results pointed out in that field. The uses of maleic acid in cotton printing are mentioned and the reasons why negative results were sometimes gotten are briefly enumerated. The application of these acids in dyeing various materials with special colors are discussed and the results gotten in using them for dyeing of leather are mentioned.

The anilides of beta oxy napthoic acid: E. R. Brunskill. If instead of beta-oxy-napthoic acid, the anilide is used for dyeing by the ice process the colors produced are brighter in shade and much faster to washing. A comparison is made of beta-oxy-napthoic acid, the anilid, toluide and p-chloranilide, coupled with aniline, p-nitraniline, para-toluidine, meta-nitro-para-toluidine, para-chloraniline-o-sulfonic acid, and o-chlor-p-toluidine sulfonic acid.

The education of the research chemist: Robert E. Rose, Ph.D. The research men turned out by the educational system of this country are excellent—this has been shown by the way the dye chemists have succeeded. If fault can be found with the system, it is with its failure to train the senses systematically during childhood, and with the emphasis placed on memory courses and second-hand data. We shall have a higher average of research attainment when we appreciate the national importance of the grade school teacher and give the calling the dignity it merits. Our universities need to escape from "text-book" teaching and our research geniuses need to be freed from routine duties—though research is only the use of the results of accurate observation as material for logical reasoning; yet to produce those who can observe rightly and think clearly is the most difficult educational problem. The American Chemical Society might aid materially by organizing a section devoted to research training where teachers and technical men could exchange views.

Extraction of resorcinol from the alkali melt: Harry McCormack. The object of the investigation reported herewith was to determine some more economical method of separating resorcinol from aqueous sodium sulphate solution obtained from the neutralization of the alkali melt in which sodium resorcinate is produced, than the customary practise of extracting with ether, or with ether and benzene. The method worked out effects the separation of resorcinol from the sodium sulphate, sodium sulphite solution, by evaporating the solution to such concentration that practically all the sodium sulphate crystallized, leaving all of the resorcinol in solution. The resulting solution is evaporated to complete dryness, pulverized and the resorcinol extracted from the dry mass by treatment with ethyl alcohol or other suitable solvents for resorcinol in which sodium sulphate and sodium sulphite are insoluble. It is found that with a 72 per cent. alcohol solution sodium sulphate is insoluble. Such an alcohol solution dissolves the resorcinol to the amount of more than 50 per cent. of the alcohol used and from this alcohol solution it is easy to secure the resorcinol by distilling off the alcohol and then purifying the resorcinol by vacuum distillation. Solvent loss amounts to 1½ to 2½ per cent. of the weight of the resorcinol.

Photosensitizing dyes: Louis E. Wise.

The preparation of lepidine and related bases: Louis A. Mikeska. Recent developments in the field of photosensitizing dyes have brought lepidine and related bases again into prominence. A procedure is given for the preparation of lepidine, p-tolulepidine and p-ethoxylepidine.

Isocyanine dyes from lepidine and its homologs: Elliot Q. Adams and Herbert L. Haller. The

quaternary addition products of sufficiently pure lepidine (or homologs of lepidine) give when treated with alcoholic alkalis in hot, concentrated solution, dyes of the isocyanine type, similar to, but not identical with, those given by the corresponding derivatives of quinaldine. The preparation of 5 such dyes is described. The formation of isocyanines from lepidine confirms the hypothesis, now generally accepted, that these dyes contain two quinoline nuclei attached to a central carbon atom in positions 4 and 2, respectively.

Kryptocyanines: A new series of photosensitising dyes: ELLIOT Q. ADAMS and HERBERT L. HALLER. A new type of photosensitizing dye having an absorption maximum near 7,000 Å. and a sensitization maximum near 7,400 Å. is described. These dyes are formed by the action of alcoholic alkali and formaldehyde (or chloroform) on the alkyl halides (or other quaternary addition compounds) of (sufficiently pure) lepidine and its homologs. Dyes of the same or similar type are produced under some circumstances in the absence of formaldehyde or chloroform. Tentative suggestions are made as to the structure of these dyes. The name "kryptocyanine" is suggested.

Synthesis of photosensitising dyes (II.), dicyanine A.: L. A. MIKESKA, H. L. HALLER and E. Q. ADAMS. Directions are given for the preparation of 2, 4-dimethyl-6-ethoxyquinoline from p-phenetidine; for the preparation of the ethiodide of this base, and, from it, the nitrate and iodide of Dicyanine A.

Naphthalene sulphonic acids. III. An alternative method for the qualitative detection of naphthalene 2–7 and 1–6 disulphonic acids. J. A. AMBLER. In naphthalene sulphonic acids. II. A method for the qualitative determination of some of the naphthalene sulphonic acids, by J. A. Ambler and E. T. Wherry, read at the meeting of the American Chemical Society at St. Louis in April, a method of detecting naphthalene 1–6 and 2–7 disulphonic acids by a microscopic examination of their β-naphthylamine salts, was given. It is also possible to detect these two acids in mixtures by the different solubility of their β-naphthylamine salts in 4 volumes of 95 per cent. alcohol and 1 volume of water, the 2–7 salt being more insoluble. The 1–6 acid is detected by converting to the sodium salts and subsequent treatment with sulphuric acid, in which the sodium salt of the 1–6 acid is more insoluble.

An investigation of the N. S. Passay of phosphoric acid and soluble phosphates: A. E. STEARN, H. V. FARR and N. P. KNOWLTON. The N. S. P. method is incapable of yielding true results except at one specific concentration, namely, 6.2 mg. per c.c. of P_2O_5 in sol. The error varies from about + 3 per cent. at a concentration of .62 mg. per c.c. to — 8 per cent. at a conc. of 10.9 mg. per c.c. This is probably due to the formation of acid phosphates of silver which are slightly soluble, the amount formed increasing rapidly as the phosphate concentration is increased and the excess of silver nitrate is simultaneously decreased. By modifying the method to the extent of transforming the acid to the tri-sodium salt results are obtained which coincide with the results yielded by the pyrophosphate method and are independent of the concentration.

The production of American storax from the red gum tree: S. A. MAHOOD.

Detection of some substituted sulphonic acids: D. F. J. LYNCH. In the work on substituted sulphonic acids in this laboratory, the need of some quick method of detection and identification for such acids as 1-8 dinitro naphthalene 3-6 disulphonic acid, 1-8 diamino naphthalene 3-6 disulphonic acid, 1-amino 8 naphthol 3-6 disulphonic acid (H acid), and 1-8 dihydroxy naphthalene 3-6 disulphonic acid (chromotrope) was felt. Mixtures of these acids were encountered in our work on the nitration of 2-7 naphthalene disulphonic acid and the subsequent reduction and hydrolysis of the nitro compound formed. Each of these four acids can be identified in the presence of the other three by the formation of salts with organic bases.

Benzene disulphonic acid from benzene monosulphonic acid: C. E. SENSEMAN. Barium benzene monosulphonate is treated with concentrated sulphuric acid at temperatures of 220°, 250° and 280°. The quantities of acid used range from 50 per cent. excess to 700 per cent. excess. The duration of the various experiments is from 8 to 10 hours. The progress of the reaction is determined in each case by removing a sample at the end of each hour and analyzing for the disulphonic acid. Vanadium pentoxide and sodium sulphate are tried out as catalysts. In some cases an increased yield of 20 per cent. results.

Qualifications of organic chemists: M. L. CROSSLEY. Uniformity of action by men who employ chemists in passing upon their qualifications is

especially needed. In addition to the training which a man receives fitting him as a chemist, he should also have a definite amount of experience before he is considered a chemist to qualify as such and should have a university training or its equivalent in the fundamentals of chemistry, physics and mathematics, and in addition, have had at least five years experience in a research laboratory connected either with the university or an industry. This can best be accomplished by appointing men who have just been graduated as junior chemists to be advanced to assistant chemist after two years of satisfactory work under the direction of senior chemists. From the assistant grade appointment should be made as a chemist after satisfactory evidence has been given by assistant chemist of his ability to understand and appreciate the responsibility to his profession in rendering efficient and accurate service. The title of chemist should carry with it distinction and should not be lightly given to men whose qualifications do not fit them for the kind of service which the chemist should render to his profession.

Laboratory equipment: C. V. OGILVIE, G. S. SIMPSON, M. L. CROSSLEY. In order to secure accuracy and efficient results in analysis in organic research laboratories it is imperative that we use standard equipment in which the factor of equipment error is reduced to a minimum. We propose two such pieces of standard equipment for laboratory purposes, first, a diazotization burette. This is a jacketed burette which can be cooled to any desired temperature by circulating brine and which can be used for diazo solutions easily decomposed by light. The burette is similar to a condenser of the shellback type, having a blue line on a white background. The lower end of this burette should be made of capillary tubing so that only a small volume of solution is held in this portion of the burette. The burette is sealed in a condenser tubing, care being taken to avoid an exposure of much of the burette surface. The inlet and outlet tubes for circulating the brine solution through the jacket are so placed as to allow the water to surround the entire burette. It is protected from the direct rays of the light by standing the jacket leaving only sufficient exposed surface of the jacket to enable the operator to read the volume of the solution. The same thing can be accomplished by using a colored solution for cooling the jacket. Second, a standard stirring equipment for use with volatile liquids. We propose laboratory stirring equipment to be used for either the extraction or mixing of volatile liquids consisting of a wide mouth flask fitted with thermometer and glass stirrer driven by a shaft which extends through a condenser. This vertical shaft is driven from a 1″ horizontal shaft 36″ above the bench. The vertical shaft is supported from the wall by iron bearings and placed 7″ from the horizontal shaft. By proper adjustment of the driving pulleys, one can carry on stirring at different heights from the operating bench. The bearings are of glass and the pulleys of wood. The pulleys have three speeds and are driven by 1/8″ leather belting. This type of equipment does away with the necessity of mercury seal which is usually necessary in work of this kind and which frequently contaminates the reaction mass.

Action of sulfuric acid on nitro carbocylic compounds: M. L. CROSSLEY. Certain nitro compounds react with sulphuric acid under certain conditions with explosive violence producing aminophenol, sulfonic acids and complex compounds of unknown composition. The reaction is exothermic and is quite general. The temperature at which the reaction takes place is just a few degrees above that at which the substances remain in contact unchanged. It is the purpose of this paper to emphasize the dangerous character of this reaction, especially when the reaction mass is large and is confined in a vessel with a closed top. On a manufacturing scale it is extremely difficult to control this reaction and it should be guarded against in processes where it might be secondary to some main reaction. A few months ago this reaction was brought about by accident in a plant in this country and it resulted in a bad explosion in which several men were badly injured and one man killed. It is hoped that other manufacturers will profit by this experience and thus prevent loss of life and property which would otherwise result.

DIVISION OF INDUSTRIAL AND ENGINEERING CHEMISTRY

H. D. Batchelor, *chairman*

H. E. Howe, *secretary*

Cellulose Symposium. G. J. Esselen, Jr., *chairman*

Regenerating book-stock: CHARLES BASKERVILLE and CLARENCE M. JOYCE. Attention is directed to the enormous amounts of old magazines and books, much of which now goes to waste, although much is converted into box-board, roofing paper, etc. The term "bookstock" is applied in this communica-

tion to used paper made primarily from chemically prepared pulp. Conservation will result in reworking more paper wastes. The differential in value of the regenerated pulp which goes back to bookstock or into boxboard must bear the cost of "de-inking." To conserve the strength and length of fiber and secure the greatest yield, the paper requires mechanical treatment whereby the fibers are loosened and drawn apart with minimum tearing; the chemical treatment should lift the ink, the substances used dissolving or emulsifying the binder and carrying the pigment particles away in the necessary washing. A combination of borax, soap, kerosene and pine oil, does this best; the last mentioned being a natural solvent of rosin, used as size for many kinds of paper, and a solvent and emulsifying body for gums and resins, which are present in ground wood, used in cheaper grades of magazine papers. The process has been patented.

Recovering newsprint: CHARLES BASKERVILLE and RESTON STEVENSON. With the prices obtaining, the recovery of old newspapers in such condition as to be used again for newsprint, offers an opportunity for relative conservation, if not distinct economy in fact. Methods previously devised for recovering printed papers made little or no distinction between newsprint stock and book stock. The former normally contains a large proportion of ground wood, which yellows on treatment with caustic soda, the usual basis of chemicals applied in de-inking printed paper stock. The authors, recognizing the difference in character of the fibers in the several kinds of stocks, have studied the fundamental principles involved and devised a novel method for completely de-inking newsprint stock containing a large percentage of ground wood with the minimum production of yellowing. The process developed depends upon the addition of American fuller's earth to the alkaline solution in which the printed or soiled newspapers are pulped. The binder is loosened and the ink lifted from the fibers, the oils being absorbed by and the ink particles adhering to the argillaceous earth, which is washed away from the fibers through a fine gauze screen. Temperature factors and concentrations are given. A finished pulp, free from pigment and binder, clean as when first made, has been obtained ready-made for the paper mill. If desired the stock may be bleached by treatment with dilute sulphurous acid, but this is unnecessary for ordinary newsprint stock.

On the cellulose content of various compound celluloses: LOUIS KAHLENBERG. Using the ferric chloride hydrolysis method described at the Urbana meeting of the American Chemical Society, various compound celluloses were decomposed and their cellulose content estimated. The following materials were thus investigated: (1) Woods—bass wood, birch, black walnut, cherry, hemlock, maple, redwood, red oak, white ash, Washington fir, white pine, yellow pine; (2) Straws—wheat, oats, rye, barley, millet, soy beans, corn stalks, corn husks, timothy hay; (3) Nutshells—black walnut, English walnut, hickory, filbert, Brazil, pecan, almond, peanut, horse chestnut; (4) Barks—hemlock, pine. So far as comparable results have previously been presented in the literature by others, the values obtained are found to be, in general, of the same order of magnitude as those in this research.

The constitution of cellulose: HAROLD HIBBERT.

The acid hydrolysis of sugar cane fiber and cotton seed hulls: E. C. SHERRARD and G. W. BLANCO. Sugar cane fiber and cotton seed hulls were hydrolyzed by digesting with dilute sulphuric acid under 115 to 120 pounds steam pressure. About 27 per cent. of total sugar was obtained from the bagasse and about 14 per cent. from the cotton seed hulls. Of the total sugar obtained from these materials very little was fermentable, the greater proportion being xylose. The yield of sugar from bagasse using Hudson and Harding's method was 21.22 per cent. of the original dry fiber. Of this 57 per cent. was obtained as crystalline xylose and shown to be identical with that from cotton seed hulls. Attention is called to the fact that pentose sugar influence the equilibrium established in the hydrolysis of cellulose of hexose sugars. When present in sufficient quantities they prevent the formation of fermentable sugars. It is pointed out that bagasse is a promising source of xylose or furfural.

CHARLES L. PARSONS,
Secretary

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter